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Unique Equipment for the Unwatering of New York City's Great Aqueduct

By Robert G. Skerrett

MUCH has been written about the various phases of the great aqueduct which is to carry water from the Catskill mountains to New York city, a hundred and more miles away. General interest has been aroused in this engineering project which, in some particulars, is a more difficult undertaking than the Panama Canal; but the public has been largely absorbed in the structural details, pure and simple. The technical task, however, is not that alone of providing a conduit for the water and then expecting that beneficent flood to flow on through stone-hewn arteries for generations to come without further consideration.

As a matter of fact, the aqueduct must be available for inspection throughout every part of it, and this is the engineer's defense against deterioration, breakdown, and the menace to health if not the denial of sufficient water to the ceaselessly increasing millions of the nation's Metropolis. So, too, from time to time various sections of the aqueduct must be subjected to one test or another, and these should properly simulate the circumstances or stresses of maximum service. Because of these requirements it will be necessary at intervals to unwater or drain great stretches of the aqueduct and to withdraw from its tunnels and shafts and pipe lines millions upon millions of gallons of water, and to do this with all reasonable dispatch.

The engineers of the Board of Water Supply of the city of New York have made preparation for just such contingencies, and the drainage equipment for the Rondout pressure tunnel and the Hudson River siphon are distinctly unique. They are this because of the conditions imposed and the facilities devised to meet successfully these unusual circumstances. The Rondout pressure tunnel contains 30,000,000 gallons of water, and to drain that portion of the aqueduct the greater part of that water must be lifted 500 feet! Again, in dealing with the Hudson River siphon, the pumping out in that case finally imposes the unparalleled task of raising the water from a depth of 1,114 feet below tide level. It called for some study upon the part of Mr. J. Waldo Smith, the Chief Engineer, and his able associates before the plan ultimately adopted was decided upon.

There were many different schemes suggested, and these eventually narrowed down to the following:

(1) Use of compressed air.

(2) Automatic bailing device, such as commonly used in mines.

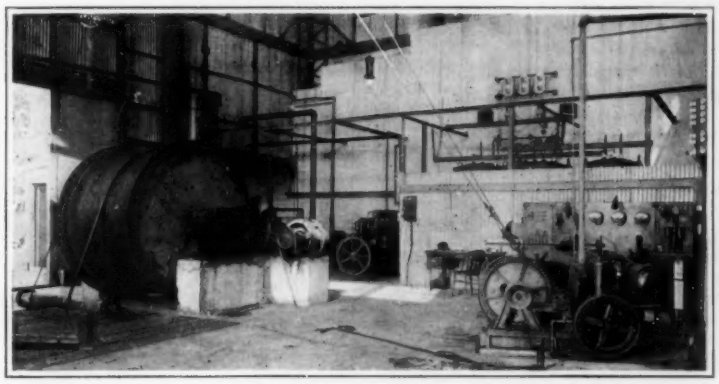
(3) Artesian well pumps in separate shafts.

(4) Mine sinking pumps.

(5) Pumping equipment to be located on a float and follow the water down.

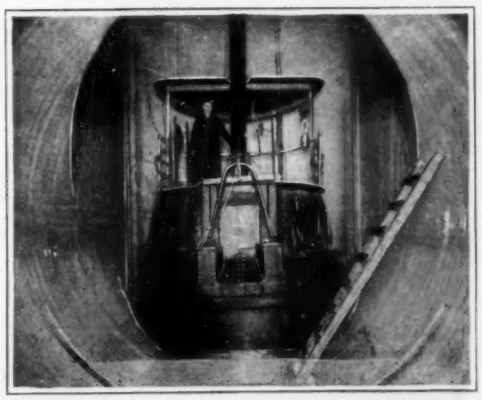
Of these the last method was chosen because it promised to be the most suitable for the problem, both on account of the minimum amount of machinery needed and the cost of masonry work involved. The drainage shaft in the case of the Hudson River siphon is the exploratory shaft on the east side of the river which was originally driven in order to determine how deep it would be necessary to go in order to get thoroughly sound rock for the tunnel running from shore to shore beneath the river. This shaft really forms an integral part in the water supply system. At a depth of 192 feet below tide level there is a connecting tunnel reaching back into the mountain for 800 feet and there linked up with the aqueduct extending southward to the city.

Ordinarily this shaft on the eastern shore of the Hudson is entirely filled with water, and the top of it is under a "head" of a little over 400 feet, because of the height of the water in the aqueduct passing through the mountains east and west of the river. Therefore, it is necessary to cap and seal this shaft by a huge dome of steel cast in one piece. This is removed when the shaft is to be drained. But before this is done the water in the system above this point is allowed to escape through blow-outs until the level is brought down to that of the tide. Then, something like 40,000,000 gallons remain to be pumped out in order to drain the siphon and the tributary parts of the aqueduct lying below the tide level. The drainage shaft has a diameter of 14 feet. In a chamber just above tide level is stored a cylindrical boat or float. This carries the pumping outfit. It is 12 feet 9 inches in diameter with a total depth of 30 feet, and when bearing its final load will have a freeboard of a little short of 2½ feet above the surface of the water.

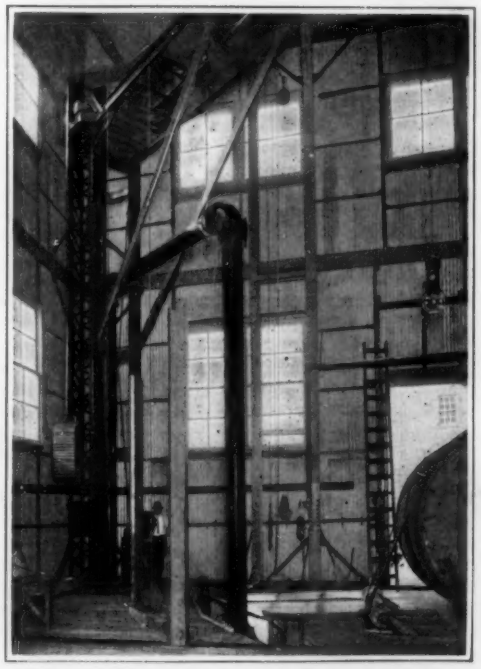


Power plant of the Hudson River siphon

Note the reel of cable supplying energy for the pumps and lights carried by the boat.



The pumping boat at the bottom of the drainage shaft of the Hudson River siphon. It carries four two-stage vertical centrifugal pumps



The gooseneck secured to the drainage pipe leading up from the boat in the shaft. Note the crane and counterweight of the gooseneck

Within this boat is installed the electric pumping plant with a capacity of something like 5,500,000 gallons daily. It contains two 4-stage vertical, centrifugal pumps, each provided with a direct-connected electric motor. These pumps discharge into a 10-inch pipe which rises vertically from the center of the boat. The discharge pipe is connected, by means of a special gooseneck pipe, to a small chamber from which the water flows away into a nearby stream or sewer. The manner of operating the pumps and arranging the exhaust conduit is interesting. When everything is ready, and the operator or operators in charge of the boat are at their stations, the pumps are started, and at once they begin the task of removing the water beneath the boat and thus promoting its gradual descent into the shaft.

In this fashion, the water is lowered about 20 feet. Then, the discharge pipe is disconnected from the gooseneck pipe which has followed it down, and another 20-foot length of discharge pipe is interposed in the line, the gooseneck joined to the upper end of the new section, and pumping resumed. Again, when the boat has gone down a score more feet, then the joint with the gooseneck is broken and an additional link in the discharge pipe inserted. The making and breaking of the joints is effected quickly, and the pumping operations are continued day and night until the water is removed in this way from the shafts and tunnels.

One of our illustrations shows the pumping equipment at the bottom of the Hudson River shaft, nearly 1,150 feet below the top of the chamber, and supporting the pipe column which is absolutely watertight. In working against this great head, the pumps have been operated in series after reaching a depth of 650 feet, *i. e.*, one pump exhausts into the other, and by this step-up process the water is finally raised to the ground level. Some idea of the service required can be gathered from the fact that the discharge end of one of the pumps reaches a pressure of about 525 pounds to the square inch. To prevent excessive leakage due to this high pressure the engineers of the Water Supply Board were obliged to devise a special form of metal packing for the stuffing-boxes on the shafts of the pumps. Nothing suitable for the work was available in the market.

The power for the electric pumps and the current for the electric lights attached to the boat are supplied by means of a heavy cable fed from a reel at the top of the shaft, and as the boat descends the reel pays out the necessary length of cable. The man or men aboard the boat are able to communicate by telephone at all times with the people above, and this circuit is maintained by a separate cable payed out in unison with the heavier one. The shaft is ventilated by forced draught—the air being led down by a canvas conduit, but the circulation is further stimulated by the heat given off by the pump motors. This induces convection, and stimulates the downward passage of fresh air from the surface. Just before the boat reaches the bottom of the shaft and settles into the sump or recess provided for it, it has to float the accumulated weight of the entire length of the discharge pipe. It is for this reason that the boat used in this part of the aqueduct has a greater displacement than that used for similar service in the Rondout section.

The boat is steadied vertically by means of concrete guides formed upon the surface of the shaft. This prevents any rotary motion. The boat with its equipment can be brought to the surface again when the siphon is refilled or it can be hoisted out. When this is done the equipment is dismantled at the bottom of the shaft and raised piece by piece. The final step consists in bringing up the float itself, which weighs about 14 tons. The pumping machinery can be used elsewhere, and is designed to be taken from place to place and reinstalled in other floats for the same service.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Problem of Mexico

THE drift of events during the past few years, and particularly during the past few weeks, has forced the conviction that some day, sooner or later, and rather sooner than later, the United States will be driven to the necessity of bringing order out of the universal chaos which prevails in Mexico; and in this connection we direct special attention to the article in the present issue on that country, written by one who has made a special study of the complicated problems of that sorely distracted land.

The fact that the author of the article is a military man lends particular significance to his conviction that the restoration of Mexico is as much, if not more, a question of civil reform than of military force. As a matter of fact it calls for the exercise of both, military force being employed only in such sufficiency as would provide for the introduction and permanent operation of civil reforms.

It has been predicted that the complete conquest of Mexico would need the employment of five hundred thousand troops. Probably it would take that number to Belgiumize Mexico, but the United States has neither the heart, nor the wish, nor the peculiar form of genius for a task of that kind. When we take hold of the Mexican problem with a firm hand and a definite purpose, we must act in the same spirit in which we entered Cuba and the Philippines. Our policy and its results in those once unhappy islands are of record. The motives were humanitarian, and the splendid results, as given in the article above referred to, stand as a proof of our altruistic attitude to the Philippine people.

All humanity is actuated by the same basic impulses, and of all the emotions the love of offspring is the strongest and most nearly universal. Hence the security of the home is the only assured foundation of government. Our success in the Philippines was directly due to the recognition of these fundamental conditions by those who had charge of our affairs out there. It took but a few years for the United States government to bring peace after a long period of alien domination. Compare this with the situation in Formosa, where the natives are still resisting Japan after all her long years of occupation. Our success in the pacification of the Philippines constitutes a high tribute to the character and ability of our officials. The dishonest white found himself in Bilibed prison as quickly as did the dishonest native; the self-seeking American office holder was soon given his papers; the inefficients were sidetracked. The insular government, acting as would a great sieve continually shaken with violence, retained only the men of large caliber and broad outlook; a few years of that strenuous administration left only the big men in office. The Philippine occupation forms one of the brightest chapters in the history of our civil and military administration. There was evidence of unselfish devotion to a high ideal—as witness the case of one Governor-General who turned his salary back into public works. It is a fact that, in all our years of occupation, not a single American official down there has accumulated even a small competence.

Our record in the Philippines stands as a proof of our good faith, which we commend to the consideration of the Mexicans and the smaller American republics.

Should the course of events (or Destiny if you will) necessitate our pacification of Mexico, we have not only the power to take over and administer the country but we have the men, all well known, most of them available, and few of whom would not be willing to undertake any personal sacrifice if called upon by the President. There are men who have lived for years among Spanish speaking and Spanish thinking people; men who have made the trial, partially failed, profited by their failures and tried again. Should we undertake such a limited military occupation as is suggested elsewhere in this issue, there is not a branch of the government which these men, rich in their Philippine experience, could not direct with a minimum of friction and administer with supreme honesty and with a single eye to the ultimate benefit of Mexico.

A Federalization that Would Be Fatal

THE Hay bill and the Chamberlain bill have been passed respectively by the House and the Senate. In the Senate, where the present diplomatic controversy with Germany undoubtedly had its effect, the Chamberlain bill was carried with scarcely a dozen Senators opposed to it, and it went through without a roll call. This bill authorizes a regular army of 250,000 men as against the 140,000 provided in the Hay bill; 261,000 volunteers, and 275,000 state militia subject to federal call. The bill also provides a system of military training for students in schools and colleges, application for the training to be purely voluntary, with the understanding that all students over eighteen years of age, by volunteering, obligate themselves to answer any federal call to the colors which may be issued by the President during their training period.

We should feel more inclined to congratulate the Senate on the passage of this bill, were it not that it contains the same serious defect that mars the Hay bill, as passed by the House. In both cases, the so-called federalization of the militia, which includes among other provisions the payment of that body, is distinctly unconstitutional. The Judge Advocate General of the army has given it as his opinion that disobedience on the part of a member of such a federalized militia would not constitute an act for which the man could be tried by federal court-martial, and this because of the inevitable clash between the proposed federal and the existing state authority.

Under the suggested arrangement the amount appropriated annually for the militia would have to be increased from the present sum of $6,000,000 to a total for the proposed militia of 275,000 of $75,000,000. Now $75,000,000 would build, equip and maintain three battle-cruisers a year, and we ask those members of the Senate who have voted for this section of the bill, whether a steady addition of three battle-cruisers a year to our fleet would not be a far more powerful deterrent to any possible enemy than the existence of a body of what any European army would call comparatively raw and untrained troops; for such the militia always has been and in the very nature of things must ever be. Let us, for example, take the case of Germany, whose troops undergo two years of continuous intensive training. To her military mind, our militia, who receive only forty-eight drills at night in armories and not to exceed ten days a year in camp, are not trained soldiers and under existing conditions never can be regarded as first-line effectives. This is not the fault of the militia, but of the system upon which it has been planned and under which it exists. We have the greatest regard for the militiaman as such, and if he is not, as he cannot in the nature of things be, a first-class soldier, since he lacks the soldier's training and experience, it is not the militiaman's fault.

In the present defenseless condition of the country every dollar that is spent for defense should be spent to the best possible advantage. Our national history has proved that the militia, as at present organized, is a force of doubtful utility; and to spend an additional $75,000,000 a year upon an experiment which has proved to be a failure is the supremest folly. Furthermore, as we noted in our issue of April 15, throughout all this attempted army legislation there has been maintained a powerful lobby of militiamen in Washington. Hence the House and the Senate now stand committed to a paid militia with all the political abuses which will inevitably arise, should this element in the bills be jammed through the House and Senate Conference Committee. The military propaganda in Washington, emboldened by its success, would now seek to consolidate itself preparatory to a fresh advance. This has ever been the history of pernicious political movements of this character. We repeat that, unless the country wakes up to the sinister meaning of what has happened, representative government itself will be threatened, and the only militarism which we have to fear, namely, a military force using political influence to gain for its members special consideration under the laws, will not only be found in our midst, but will soon set itself to the task of becoming the dominant political power.

Universal Time

HAVING annihilated space by means of the electric telegraph, man found himself face to face with a daily and hourly paradox. A cablegram leaves England at noon, and in the proverbial "twinkling of an eye" arrives at its destination in India. The Indian operator looks at the clock. Does it mark the noon hour? Not at all. Notwithstanding practically instantaneous transmission, the despatch does not reach India until 5:30 P. M. Even more curious is the result of telegraphing in the opposite direction. A message is wired from Greenwich at noon, and it reaches New York at seven o'clock in the morning of the same day—five hours earlier than it was sent!

These statements involve contradictions in terms with which we have become so familiar that they have lost their strangeness. Nevertheless the contradictions remain. When it is *now* in London it is neither more nor less than now in Calcutta and New York. Call it what you like, the time remains identical. But why this bewildering diversity of "times," when there is really only one time?

The answer is easy. We have inherited from our remote ancestors their primitive conceptions of the time o' day, just as we have inherited many other primitive conceptions which, but for the mental inertia of our species, would have passed into oblivion long ago. Early man found himself provided with a ready-made timepiece in the shape of the sun. Sunrise, high noon, and sunset were the events that marked off the progress of the day. The daylight period, or "natural day," which circumscribed most human activities, was the all-important time-interval. Even when the ancients divided their day into hours, it was the natural and not the civil day that was so divided. In Greece and Rome there were 12 hours between sunrise and sunset—hours that were long in summer and short in winter. The advantages of using hours of uniform length were so little appreciated, that the more elaborate forms of water-clock, or clepsydra, were, with great ingenuity, constructed so as to vary their pace with the season; an expedient comparable in its naïveté with the attempts made in comparatively modern times to construct mechanical clocks that should take account of the equation of time and keep pace with the sun-dial. One can imagine the perplexity in which an ancient Greek or Roman horologist would have found himself involved if he had traveled to circumpolar latitudes, where the "natural" day, at its maximum, lasts for weeks or months, and each of its "hours" (according to the classical conception of this time-unit) would be several modern days in length.

But only the astronomer and the mariner have completely broken away from the parochial time-keeping system of antiquity, and then only for certain purposes. Greenwich time prevails in the observatory, but must frequently be translated into local time. Ships' chronometers keep Greenwich time, but ships' bells a makeshift local time.

The idea of making Greenwich mean time universal is not a new one. When standard time was adopted in America there were many advocates of the plan of using one kind of time instead of five. The International Time Conference which met in Paris in 1912 declared that "the universal time shall be that of Greenwich," and the wireless time signals of the world are now based upon this decision.

One might hazard the prediction that the day will come when only one kind of *standard* time will be used throughout the world—viz., that of the meridian of Greenwich—but this does not mean that we can do without local time. Probably the present system of time zones, with their very irregular boundaries (determined in America by the exigencies of the railways and in Europe by political frontiers), could be abandoned altogether. The clocks in railway stations and telegraph offices might keep identical time in England, India, China and America. The curious fiction of the International Date Line could be given up. We might even apply the nomenclature of the Greenwich clock to our office hours and our meal hours. It would, at first, seem strange to the New Yorker to begin work at 4 A.M. instead of 9 A.M., and dine at 2 P.M. instead of 7 P.M., but as these changes would be merely nominal and involve no dislocation of his habits with respect to daylight and darkness, he would soon become accustomed to them.

On the other hand there are certain purposes for which it is essential that the record of time shall furnish some indication of the local hour-angle of the sun. Suppose, for example, it is a question of drawing a curve to show the daily march of temperature. The time coördinates of such a curve would be meaningless for both practical and scientific purposes if labeled in Greenwich hours; unless, of course, the place to which the data referred happened to lie on the meridian of Greenwich. It should be noted that the standard time now in vogue is also, though in a less degree, inappropriate for such uses, except in reference to events that occur on one of the standard meridians. Indeed, for refined observations we need not only local time, but "apparent" (or sundial) time.

Two corollaries suggest themselves. First, universal time has no use for "A.M." and "P.M." The hours should be numbered from 1 to 24 (as they are already in many countries). Second, the phraseology employed in naming the time of day should indicate whether universal or local time is meant by some briefer method than is now available.

Automobile Notes

"Fat Sparks."—A great deal is written about the efficacy of a "big, hot spark" in producing increased motor efficiency and speed; but reduced to actual facts the increasingly hot spark from a magneto, resulting from higher motor speed, is only of advantage in as far as it tends to clear the soot from the plugs. This hotter spark is the result of higher motor speed, and not the cause.

Simplified Lubrication.—In view of comments recently made in this column in regard to the innumerable little spots around controlling levers, brake rigging, etc., which ordinarily depend for their lubrication on a varied assortment of oil and grease cups, carefully tucked away in unsuspected corners where many of them are never found after the machine leaves the shop, it is interesting to note that an oil-less bearing has been developed which, it is claimed, takes care of these small, but important points, and relieves the owner of much trouble and worry.

A Suggestion in Preparedness.—In the discussions about preparedness it has been prominently suggested that a belt line road be built around the United States, near the sea coast. Such a road would be of undoubted value; but enthusiasts in this direction apparently lose sight of the fundamental fact that, either for war or peace, we need good roads everywhere. Another lesson that can be drawn from the experience of Europe of late is to so build the roads that they will stand up in time of need. If our special war roads were built by the average county official they would probably not survive actual war conditions over a week.

Motor Vehicles in War.—It has been quite generally recognized that France was saved, in the early days of the war, by the aid of motor vehicles, which enabled rapid mobilization of troops and supplies to be effected; and since that time, in this mechanical war, the uses, and the necessity for motor vehicles have grown to such an extent that it is fully recognized that the army that is best supplied with transportation facilities, both for men and supplies, easily dominates one of equal strength that is not so equipped. It is humiliating that our government is so oblivious to the world's progress, but some of our motor associations and our National Guards, in some states, are agitating the matter of organizing military motor transportation squadrons for the purpose of study and experiment.

40-Cent Gasoline.—It is freely predicted, and with every possibility of coming true, that the price of gasoline will go to 40 cents within a short time, and this can hardly be regarded as less than a catastrophe, especially at this time when business men are just beginning to appreciate the value of motor trucks for commercial purposes. This situation raises a point on which makers of motor vehicles have been noticeably silent, and that is the use of heavier fuels, which seems to be vastly more important than some of the improvements that have been occupying attention of late. An engine operating on distillate, kerosene or some other cheap fuel would be the salvation of the commercial vehicle business, and would appear to be absolutely vital where the much talked of farm tractors are concerned.

A Divided Exhaust Manifold.—What appears to be an excellent idea is the divided exhaust manifold that has been adopted by one manufacturer. It has been more than suspected that the ordinary type of exhaust manifold is not conducive to a free escape of the gases, as the violent discharge of cylinder nearest the outlet of the manifold is likely to back up the previously discharged gases from cylinders nearer the dead end of the manifold. In the design in question, which is for a four-cylinder engine, the manifold is composed of two separate passages contained in a single casting, which combine in a single outlet. Cylinders 1 and 4 connect with one of these passages, and cylinders 3 and 2 with the other, which would appear to give the gases an ample opportunity to establish a flow in the right direction before they are broken up by an opposing discharge.

Ignorant Drivers.—The number of furiously steaming radiators to be noticed, even on the coldest days, calls attention to the fact that the average driver of a motor vehicle has very vague ideas about operating his engine—and this is only one point in which he is lacking. The prevailing error seems to be in running with full throttle and retarded spark, a sure method of overheating the engine, and one which would soon result in disaster if the cooling apparatus was not extremely efficient. Even as it is such practice does the engine no good. When speed is to be reduced the first operation is to check the throttle until there are signs of knocking, when the spark may be gradually retarded; and when increasing speed the operation is reversed, the spark being first advanced, followed by opening the throttle. Many a lowly motorcyclist, with his air cooled motor, could give points to the superior automobilist on efficient and economical driving.

Science

The Gilbert and Ellice Islands, in the Pacific Ocean, which were proclaimed a British protectorate in 1892, have now been annexed to the British Empire as a crown colony. The population of these islands was reported in 1911 to be 26,417 natives and 446 foreigners.

The Ecological Society of America, which was organized at the time of the Columbus meeting of the American Association for the Advancement of Science, last December, has already enrolled more than 200 members. Dr. Victor E. Shelford, of the University of Illinois, is president; Prof. W. M. Wheeler, of Harvard University, vice-president; and Dr. Forrest Shreve, of the Carnegie Desert Laboratory, Tucson, Ariz., secretary-treasurer. The society will hold an annual meeting for the reading of papers, and will also organize field meetings from time to time in various parts of the country. During the present year field meetings will be held in the neighborhood of Chicago in June and at San Diego in August.

War Changes in Geographic Names.—It is announced in *La Géographie* that the French admiralty has replaced the numerous German geographic names in the French subantarctic island of Kerguelen by names of French origin. We join heartily in the wish expressed by our British contemporary *Nature* that similar practices may not be carried too far. Any change of this sort is a potential cause of confusion, not to mention the expense entailed upon the publishers of geographical and other reference books. We have already noted in these columns several previous changes in names due to the war. In this connection it is interesting to record that German writers and publishers have almost unanimously ignored the change in the name of the Russian capital to "Petrograd."

The Dangers of Wood Alcohol are just now attracting much attention, not only on the part of the public but also, fortunately, of legislative bodies. A note in *Public Health Reports* records the progress of the campaign against this substance during the year 1915. The National Association of Retail Druggists adopted a resolution opposing "the use of wood alcohol in medicinal preparations to be used by human beings," and in favor of such labeling as would protect the public against its harmful use. Two states, New Hampshire and South Dakota, each enacted a law restricting the sale of wood alcohol and prescribing a form of label to be used. The South Dakota law debars its use in any food, drink, medicine or toilet preparation intended for human use, internally or externally. The cities of New York, Chicago and Montclair, N. J., have adopted regulations or ordinances restricting its use.

Zoological Station in British Guiana.—A new undertaking of the New York Zoölogical Society is the establishment of a tropical station in British Guiana, for the study of the evolution and life histories of the local fauna, especially birds. Funds for the first year's work of the station were furnished by Messrs. Cleveland H. Dodge, Mortimer L. Schiff, C. Ledyard Blair, James J. Hill, and George J. Gould; while the government of British Guiana has offered the use of its botanical gardens and wild government land. The officers of the new station, who sailed from New York January 22d, comprise C. William Beebe, curator of birds in the New York Zoölogical Park, in charge; C. Inness Hartley, P. G. Howes, and Donald Carter. It is proposed to build a bungalow at the edge of the jungle and equip it as a laboratory. One of the first birds to be studied will be the hoazin (*Opisthocomus cristatus*), of which there are no specimens in captivity, and concerning which there has been much controversy. One function of the station will be to collect and forward regular supplies of living animals for the New York "Zoo."

The Growing Love of Wild Birds among the people of this country is commented upon in the last annual report of the U. S. Biological Survey. Everywhere efforts are being made to increase the number of birds and attract them to the vicinity of homes. This movement is said to be partly æsthetic, but also partly due to a growing appreciation of the usefulness of birds as insect destroyers. The report declares that "the increase of interest in wild birds throughout the United States during the past decade has been phenomenal, and organizations having for their chief object the care and protection of birds are numbered by hundreds, if not thousands." Efforts to attract birds to city parks and suburbs have been made by many civic leagues and women's clubs. In order to aid this interesting movement the Department of Agriculture issued last year two publications, entitled "Bird Houses and How to Build Them" and "How to Attract Birds in the Northeastern United States." The latter is the first of a series planned to cover all parts of the country. These publications devote special attention to the kinds of fruit-bearing shrubs and trees that are important as furnishing food for birds.

Aeronautics

An Aerial Ambulance, it is reported, is being built by a California manufacturer, and army aviators at San Diego, Cal., have been permitted to see it. Under the body of the aeroplane is slung a small cot, which is so fastened and constructed that it will be impossible for the occupant to fall out or even be shaken when the aeroplane volplanes to earth. It is understood that while the craft is en route to the hospital a trained attendant will be enabled to give first aid to the patient.

A German Anti-Aircraft Gun.—The Germans are using at the present time a 104 mm. anti-aircraft Krupp gun, 45 calibers long, which sends a projectile weighing 15½ kilogrammes, with a muzzle velocity of 800 meters, to a height of 4,000 meters. It can be fired at the rate of 15 rounds per minute. The shrapnel shell which it fires is said to burst into 625 fragments. Guns of this type, as well as those of 120 mm., are the ordnance which defends Ostend.

German Aviatik of New Type.—A new type of Aviatik biplane was recently brought down behind the French lines. Its wings, which no longer sweep back as in the earlier types, measure 41 feet in span, with a chord of 6.4 feet. The structure is of oval steel tubing throughout. The engine is a 170 horse-power Mercedes driving a Garuda tractor. The weight, empty, works out at 1,600 pounds, and the useful load, including armament, amounts to approximately 1,300 pounds. The machine is exceptionally fast and has a climbing speed of 4,000 to 4,500 feet in fifteen minutes.

Fifteen-Ton Flying Boats for British Admiralty.—The British Admiralty has ordered 20 triplanes similar to the 15-ton Curtis flying yacht which is now being completed at a plant near Buffalo, according to a recent statement of Henry Woodhouse, governor of the Aero Club of America. The spread of the planes of these machines will be 133 feet, and the propulsion will be supplied by four 12-cylinder, 250 horse-power motors. An auxiliary motor will be provided to drive a screw propeller, so that the craft can be navigated at slow speeds on the surface of the water.

Transatlantic Flight by Aeroplane.—It is reported that Rodman Wanamaker is preparing again for a flight across the Atlantic Ocean in an aeroplane. A machine for the purpose is now building; it is said to be a giant triplane of larger proportions than anything hitherto attempted, mounting motors capable of developing 1,800 horse-power. The present understanding is that the flight is contemplated for the early part of the coming summer, and that the pilot for the trip has not yet been decided upon. The course, too, is still undecided, although it will probably be laid from St. Johns, N. F. The fact that details concerning both the aircraft being built and the contemplated journey are being withheld from the public, renders impossible any comment on the undertaking, for the present at least.

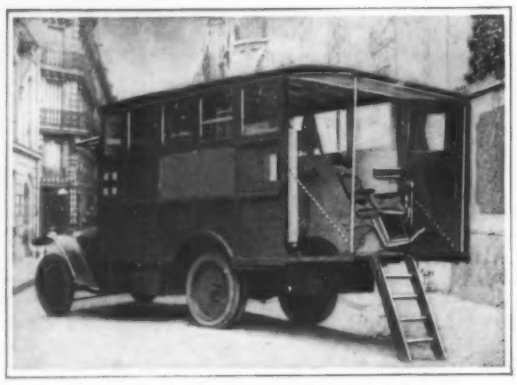
The Causes of British Casualties among aviators was a topic of keen discussion in the House of Commons recently. Noel Pemberton-Billing, lately elected on the air preparedness issue, stated that a series of casualties with a total of 150 dead, 150 wounded and 105 missing was due to the sending of British aviators to the front in aeroplanes which were outclassed hopelessly by German machines. Harold J. Tennant, Parliamentary Secretary of the War Office, made conciliatory answers to these charges and assured Mr. Pemberton-Billing that he was wholly misinformed, although admitting that at present a majority of German machines were probably faster than the bulk of the British machines. He added, however, that the disadvantage was only a temporary one, and the near future would witness the British aviators on superior mounts.

Heart Action at Great Altitudes.—Dr. G. Ferry, a Frenchman enjoying the rank of *Aide-Major de 2e classe au Parc d'Aviation*, brings forth some interesting facts regarding blood pressure at various heights in a recent issue of *La Presse Médical*, which are based on careful records made during a number of flights. His conclusions are: The pulse becomes more and more rapid from the ground up to a height of 750 meters. From this height to 1,250 meters it still augments, but less rapidly. Above this height it again accelerates more rapidly. The period of slower acceleration seems to be explained by the fact that between 750 meters and 1,250 meters the air is usually calmer than at lower altitudes, and the wind more regular. Above this height the cold becomes a great factor in acceleration. Each time a gust strikes the aeroplane the pulse accelerates. During a flight at a particular altitude the pulse remains constant. When descent begins there is again for a very short period a quickening of the pulse, due, it is thought, to the thrill of excitement experienced when the engine is shut off. After this the frequency falls in a regular manner during a slow descent. Each "event" in the descent causes an acceleration, short, but definite. The pulse at the end of the flight is always more rapid than at the beginning.

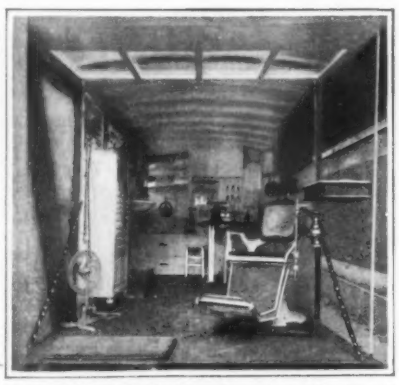
Automobile Dental Shop of the French Army

By Jacques Boyer

SINCE meat is the predominating food of troops in active campaign according to French practice, the soldiers must possess either good teeth or artificial ones in the proper condition to permit of the thorough mastication of food. It is accordingly necessary to provide dental specialists at the front who are capable of attending to the teeth of the soldiers in order that the numerous ailments arising from defective teeth may be avoided, for they lessen the soldier's efficiency.



Traveling dental shop now in use in the French army



Interior view of the French automobile dental shop

There is in operation a dental service situated a considerable distance in the rear of each army corps on the French front, usually 30 to 40 kilometers distant from the first-line trenches. But the main difficulty in connection with the existing service is that the men on active duty find it seldom possible to travel back to the dental stations. More often, dental troubles are attended to by the men themselves or by doctors, who use a pair of forceps to extract troublesome teeth for want of dental knowledge and equipment. Obviously, such a radical procedure is incorrect and unfair to the men, hence there has long been a need for a traveling dental shop, provided with all the necessary equipment and a skilled personnel, following the regiments on the march and at all times situated as close to the front as possible.

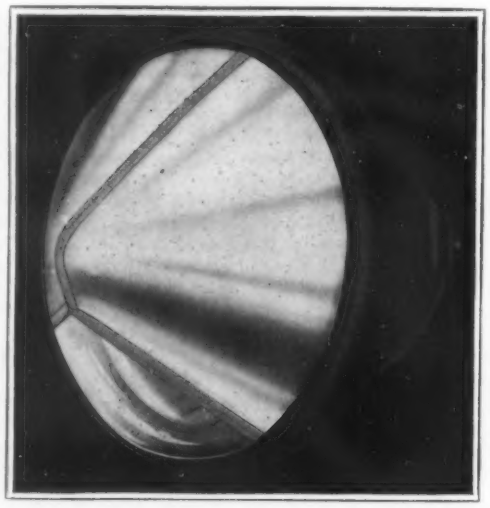
There has recently been devised by Doctor M. Gaumerais, attached to the complementary hospital 81 of the French army in the capacity of adjutant, an automobile dental shop which solves the problem of giving proper attention to the dental ailments of the soldiers. The shop is known as the *voiture de stomatologie*, and is installed in an automobile bus of a standard model used in the French army. The interior is of sufficient height to permit the men to stand erect. About two thirds of the depth on one side is occupied by a cabinet containing all the necessary dental supplies and instruments, and the remaining space is devoted to the dental laboratory or workshop where the mechanical work of dentistry is accomplished. In the former portion of the traveling dental shop is also included a standard chair, mounted on a platform provided with castors so that it can be moved about.

The rear end of the traveling dental office consists of an upper and lower half, both of which are hinged. While traveling the two halves are closed. When the shop reaches its destination the two halves are opened; the upper one forms a roof and is equipped with glass windows which act as a skylight, while the lower one, supported by side chains and iron rods reaching to the ground, provides additional floor space. It will be noted in the illustrations that this feature causes considerable space to be added to the dental shop when the automobile is at rest, and that the extended portion can, if desired, be inclosed by using canvas curtains. It is in this extended portion that the movable dental chair is brought, where the dentist will have plenty of light to aid him in his work on the patient. The accompanying illustration showing the interior view of the traveling dental office does not fail to disclose the completeness of the equipment.

According to official reports, the rolling dental shop was used for 1,800 dental operations of different kinds during the month of October, 1915, not including 63 cases of purely mechanical dentistry. Unfortunately, the personnel of the shop only includes Dr. Gaumerais, aided by a dentist and a mechanical dentist, hence the utility of the shop is limited in its scope. It would be necessary to multiply the number of automobile dental offices so that each unit could be devoted to four army corps, in order to render the proper dental care to all those in need of it.

A Detachable Headlight Dimmer of Novel Design

HEADLIGHT dimmers in almost endless variety are not lacking in these days of strict municipal ordinances, but it is doubtful if any are more novel than that recently introduced by an American manufacturer. The new dimmer is made of pyraline—a strong, flexible and transparent material—with an expansible material that fits snugly over the outside rim of the headlight, which holds the dimmer in place irrespective of weather conditions. The dimmer is provided with a seam through the center which permits it to be collapsed when not in use. When fitted over a headlight, it permits the uninterrupted projection of the rays of the lamp through an opening at the bottom, but diffuses such rays as would ordinarily blind the drivers of vehicles moving in the opposite direction.



A headlight dimmer that may be readily attached and removed at will

An Apartment That Travels on Wheels

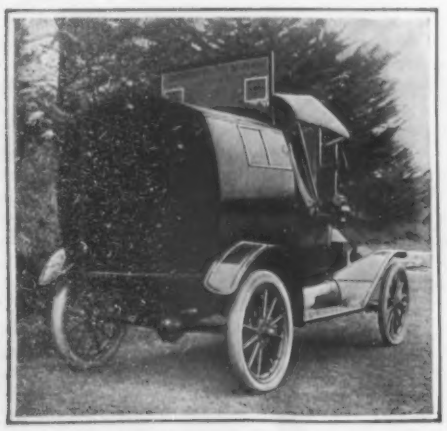
WHILE it is true that in numbers the automobile camping outfits which have made their appearance in the recent past have not been lacking, it can likewise be said that no great degree of originality has been displayed except in a few isolated instances. For the most part the motor car camping equipments have been crude and distinctly of the home-made variety. It is for this reason that the so-called "automobile telescope apartment" recently introduced by an American inventor commands interest.

The automobile telescope apartment can be attached and detached from any light automobile chassis in 15 minutes, according to the claims of the designer. Its total weight is only 175 pounds. As will be noticed in the accompanying illustrations, while on the road the equipment is entirely inclosed in a box-like body, which is mounted over the portion of the chassis ordinarily occupied by the tonneau, or, in the instance of a runabout or racing model, the portion devoted to the sloping rear body or large gasoline tank. On the other hand, when at rest the furniture of the transportable apartment is spread out. It includes a comfortable folding-table, provided with two folding chairs; an oil stove and kitchen closet, replete with pots, pans and other utensils, as well as table ware; a closed-bed which will readily accommodate two persons, and a number of drawers for clothing and other articles, as well as storage space for baggage. So compactly does the equipment fit into the box-like body that at first glance one is apt to be incredulous as to whether all the articles have been transported by the automobile. Yet a study of the illustrations reveals how ingeniously the designer has fitted the different parts of the equipment into the body.

The traveling apartment is said to be excellent for light housekeeping while on a lengthy tour. Electric lights, placed over the kitchen section and over the dining table, add the final touch of refinement to the profuse equipment.

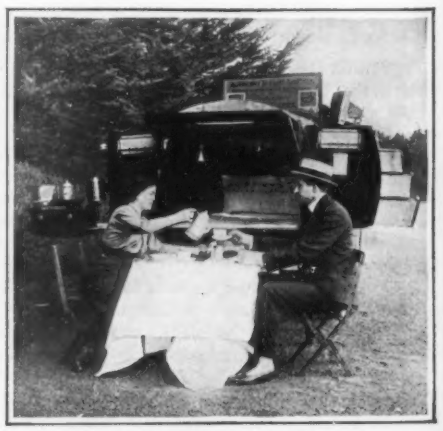
The Current Supplement

THE glaciers that exist in various parts of the North American continent are unsurpassed in size, picturesqueness or general interest. Some of them are described in *Some American Glaciers* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No. 2104 of April 29, and it is accompanied by a number of excellent illustrations. The second article on *Economy in Study* appears in this issue, the subject of this instalment being *Educative Imagination*. *Field Cables* describes and illustrates how telegraph lines for maintaining communication between headquarters and the various divisions of an army are maintained on the battle front. *Leaf Photography* tells of peculiar chemical characteristics of the leaves of plants, and illustrates some interesting experiments that may easily be made. *Lutes and Cements* gives the formulæ for a number of compounds that will be found of great value to the chemist and the physicist in their every-day laboratory work, and to the investigator generally. *Electric Cooking Ranges in Hospitals* describes and illustrates a simply operated equipment used where a large number of people must be fed promptly, economically and with a minimum of labor. *Farm Tractors* briefly reviews the history, conditions of use and methods of construction of a power implement that must prove of vast value to the farmer. *Mica* summarizes much information relating to an interesting and widely useful mineral. *The Blind Spot* describes a peculiarity of the eye that is a source of danger, and which might explain the cause of many accidents, both of automobiles and railroads. Other articles of value include *Notes on the Eucalyptus Oil Industry in California, Annealing Furnaces* and *Dangers of Rubber Manufacture.*



Automobile telescope apartment on the road

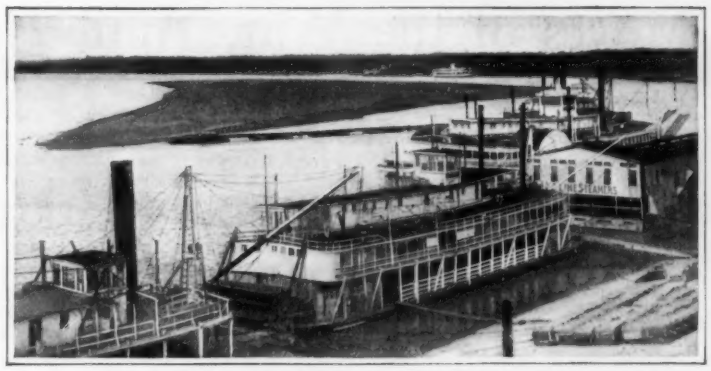
Side view of the automobile apartment, showing the kitchen



Housekeeping by the wayside while en route

An Island of Mud that Threatens Memphis Harbor

THE accompanying illustration shows the mud bar formed in the Memphis harbor by a whim of the erratic Mississippi, an obstruction now occupying what had formerly been a deep water channel entering one of the most accessible harbors along that entire waterway. The bar, called the "mud isle" by rivermen, is now estimated to contain, in round numbers, 5,000,000 cubic yards of silt deposit—an accumulation of several years. When the fact is borne in mind that on October 10, 1913, it first appeared above water as a small shoal, and two years later emerged as a forty acre tract, eventually joining itself to the mainland by a narrow strip, the rapidity of its formation can well be imagined.



View of Memphis harbor looking north, showing the island of mud that has recently formed

In the fall of 1910, soundings revealed the fact that a bar was forming, and as early as 1912 its presence had become a menace to traffic. A survey of the island, made at the time when the water gage registered a twelve-foot stage, determined the length of the bar to be 2,800 feet long and 600 feet across at its widest point. These measurements were made early in November, 1915. The narrow strip of water separating it from the mainland measured 500 feet across at that stage. When the river continued to fall and the upper end of the chute pictured closed up, incoming packet steamers were forced to avail themselves of the little remaining wharfage space.

With the gradual building up of a headland point, a half mile above the harbor, the main current of the stream was deflected towards the Arkansas shore. This is given as an explanation of the bar's formation, for the swift water, no longer following the wharf line channel, permitted an eddy to form. When this occurred, mud deposits by the river became inevitable.

A plan to assure the eventual removal of the mud bar was approved and adopted by the Mississippi River Commission in recent session. The specifications call for a canal with a fifty-foot base line to provide a 200-foot channel, to be cut through this headland tract at an angle in line with the chute along the Memphis water front, through which will be directed the waters of the Wolf and Loosa Hatchie rivers—two small tributary streams emptying into the Mississippi a short distance above the harbor. The proposed canal, instead of permitting these waters to enter the river at a point where they will be carried by the main current towards the Arkansas shore, is expected to utilize their force in keeping the harbor chute free of sediment and to help in washing away the silt accumulation, by restoring a swift current to rout the eddy responsible for the mud bar.

The cost of the project determined upon is placed at $150,000, of which amount $55,000 is available. Congress will be asked to appropriate the remainder of the sum needed to complete the work, now well under way. In the meanwhile, Federal engineers are keeping dredges at work, maintaining a proper depth in the channel that remains. Recent high water stages may make this course unnecessary.

The Kaiser as a Draughtsman

WE have all of us heard about the versatility of the Kaiser—how he can draw, paint, compose an opera, give suggestions as to the design, execution and grouping of statuary, and, if occasion should require, as in the present war, can fill the position of commander-in-chief of the greatest fighting machine the world has ever seen.

The above enumeration by no means covers the field of his abilities—or shall we say his activities?—but just here and now we invite the attention of our readers to an extremely interesting reproduction of an original drawing by the Kaiser, made some twenty-five years ago, and given by him to an American friend of his, Mr. Poultney Bigelow, who as a boy was a playmate of the young brothers, William and Henry, at the New Palace, Potsdam, and in later years was on terms of considerable intimacy with the Kaiser.

The original is in the collection of the Naval History Society, which for the present is housed in Aeolian Hall, 42d Street, New York, and it is by the courtesy of the secretary-treasurer, Mr. Robert W. Neeser, that we are enabled to make the present reproduction in the SCIENTIFIC AMERICAN.

We are informed by Mr. Bigelow, who presented the drawing to the society, that it was made in pencil on one half of a large sheet of blotting paper, which formed part of a folder pad used by the Kaiser at the palace. On the reverse of the sheet are several bow and stern views of ships, one of which is reproduced in the corner of our engraving. On the opposite half of the sheet of blotting paper are more drawings and the blotted signature of the Emperor, "Wilhelm I. R.," to a letter written "A Sa Majeste Le Roi D'Italie."

It should be noted that the Emperor's signature is in the bottom right-hand corner of the drawing, and that it reads "Neues Palais, WR, November, 1891." The rest of the writing, in our opinion, is in another hand, for in view of the fact that the drawing is a very close approximation to the French battleship designs of the year 1891, we are satisfied that the Kaiser would never have claimed to be the original designer of the type of ship here shown.

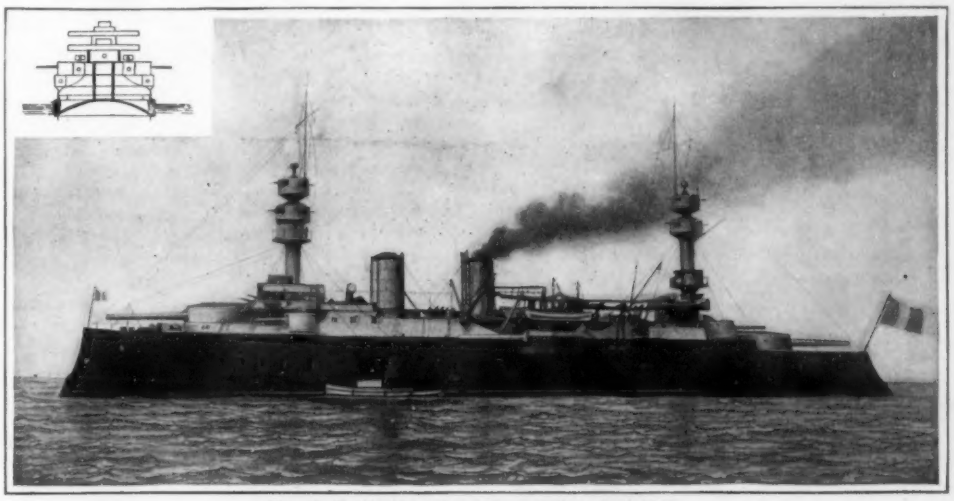
In proof of our contention, we give an illustration of the French battleship "Jauguiberry," which was launched in 1893 and whose design, therefore, was probably well known to the German Intelligence Service, and therefore to the Kaiser himself when this drawing was made. We draw attention to the characteristic abnormally projecting ram bow in the drawing, to the tubular military masts, with their machine guns mounted in enclosed tops; to the large, square portholes, to the disposition of the main battery of four guns in four turrets, one forward, one aft and one on either beam; and to the extreme tumble-home of the sides.

It is probable that the Kaiser made this rapid pencil sketch of the latest type of French battleship on his blotting pad either for his own amusement or to illustrate a description which he was giving at the time of what the French were doing.

The Naval History Society, which owns the drawing, was founded in 1909 with the object, as stated in the articles of incorporation, of discovering and procuring data, manuscripts, writings, and whatever may relate to naval history, science, and art, and the surroundings and experiences of seamen in general in general and of American seamen in particular, and to preserve the same by publication or otherwise.

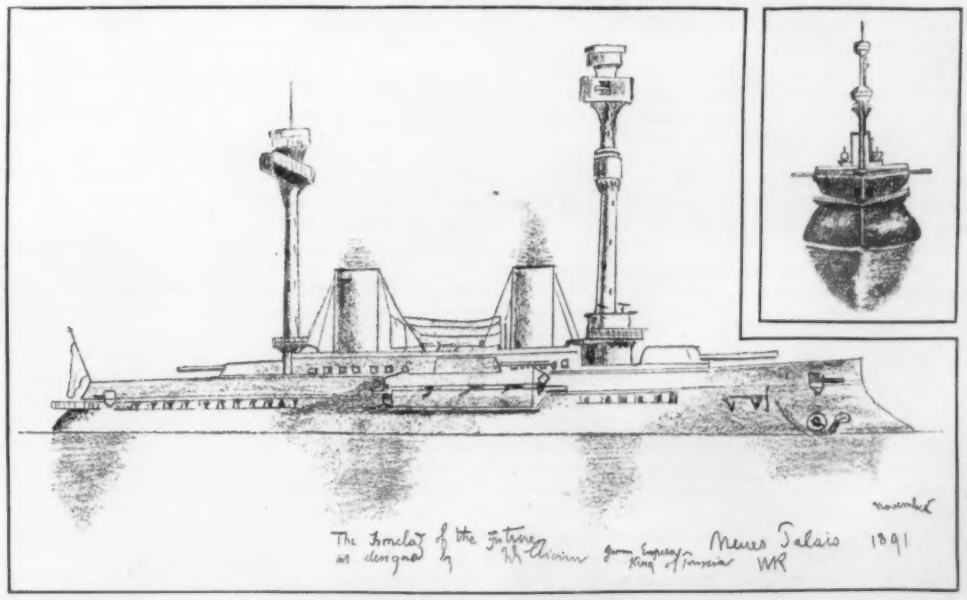
The collection, in spite of the comparative youth of the society, is already of great value and full of very strong interest, and during the present month there is an exhibition at Aeolian Hall of original manuscripts, engravings, prints and books relating to John Paul Jones. The society's collection includes the John S. Barnes Memorial Library; the papers of John Ericsson; the papers of Admiral E. Y. McCauley, U. S. N., including his journal of the Perry expedition to Japan; two volumes of transcripts from the British Admiralty in London of the Out Letters, Secret Letters, Orders and Instructions issued by the Admiralty to Admiral Thomas Graves, R. N., on the North American Station, 1781; and extracts from the logs of ships in his fleet. Among the publications of the society are the logs of the "Serapis," "Alliance," "Ariel," under the command of John Paul Jones, 1778-1780; the narrative of Nathaniel Fanning, an officer of the Revolutionary Navy; letters and papers relating to the cruises of Gustavus Conyngham, a captain of the Continental Navy, 1777-1779.

A building committee, with Hon. Franklin D. Roosevelt, Assistant Secretary of the Navy, as chairman, has been formed for the purpose of erecting a suitable home for the society, and various sites in the City of Washington are at present under consideration.



French Battleship "Jauguiberry," launched 1893

This ship is representative of the French battleship designs of the year 1891. Note the big gun positions, the tubular military masts, and the large square portholes. Compare quadrilateral position of main battery, tubular masts, tumble-home of sides, etc., with the drawing below.



Reproduction of a drawing by the Kaiser

The original (now in the collection of the Naval History Society) was made upon a sheet of blotting paper, and subsequently given to an American friend.

Strategic Moves of the War, April 21st, 1916

By Our Military Expert

IT is about 550 miles by land from Trebizond to Constantinople, as the crow flies; and from the character of the intervening ground that would be the least inconvenient way to get there, for marching is, to say the least, a trifle difficult.

It is unfortunate that the limited size of the SCIENTIFIC AMERICAN prohibits the publication of a detailed map which might adequately represent the difficult terrain of the Asia Minor peninsula. Practically the entire country occupied by that section of the Russian army of the Caucasus extending from Trebizond to the vicinity of Diarbekir, is forbiddingly mountainous. Near Diarbekir the Russian line sags eastward through a country rimmed by mountains which look southward over the more open spaces of El Jizerah, the section comprehended between the broad upper reaches of the Tigris and the Euphrates. Kurdistan, south of Bitlis and south of Sasun, forms a momentary flat country, over which the Russian columns are hurrying, the lash to the whip.

From about fifty miles southeast of Diarbekir, the loops of the Euphrates seem to hold the mountains westward, toward the Gulf of Alexandretta, that salient of the Mediterranean which juts so sharply northward into the peninsula.

But the entire peninsula of Asia Minor is a latticework of mountain ranges, except for the comparatively small section in the center, about the Tuz Gol, the salt lake to the southward of the great loop of the Kizil Irmak River.

Roads are at a premium. The infrequency of highways with which Russia has to contend in her major operations on the main eastern line from Riga to Bessarabia, is as nothing in comparison. The country itself affords little provender to an invader. It is not profusely agricultural at best and its resources have been taxed already to supply the Teutonic allies as much as possible. This resultant barrenness has forced the Russian armies to rely almost entirely upon their lines of supply; and the difficulties of the task must be apparent to even the least studious reader.

The Grand Duke's drive is a magnificent venture, with some prospect of success—if the Central Empires can be kept busy enough elsewhere to prevent the detachment of strong forces to oppose his progress. In general, it is a drive upon Constantinople, as a secondary objective to the isolation of the main Turkish possessions from the Ottoman seat of government. But for either to be successfully achieved, a flank cannot be left up in the air; and as only the southern flank is movable, insecured, it must swing around from the Persian Gulf and sweep the country before it—a tremendous task. Already its extremity is southwest of Ispahan; a section is in the vicinity of the Persian-Turkish border near Khanikin, a hundred miles northeast of Bagdad. And the space intervening between there and the Diarbekir sector is intervaled by columns of troops, although, apparently, in comparatively slight strength; merely connecting elements.

It is not inconceivable that if the main Russian forces operating to the northward manage to extend toward Alexandretta, *Entente* forces may be landed at this point under the guns of their warships, in the effort to effect a more speedy coupling of the line. But this cannot be done until there is ample promise of success, for the point is directly on the main line, where every factor would favor the Teutonic forces. This is not a prediction, by any means; it is merely the suggestion of a possibility.

It will be found, when the war is over and the full story is told, that one of the masterpieces of military achievement to date is the manner in which the army of the Caucasus has been supplied with food, ammunition and equipment. When it is realized what stupendous quantities of these commodities are absolutely necessary to the very existence of an army, what a force of men is necessary to handle them, and the quantity of transportation units required to shift them, absolutely without assistance from railways in the theatre of operations, some comprehension of the feat may be had.

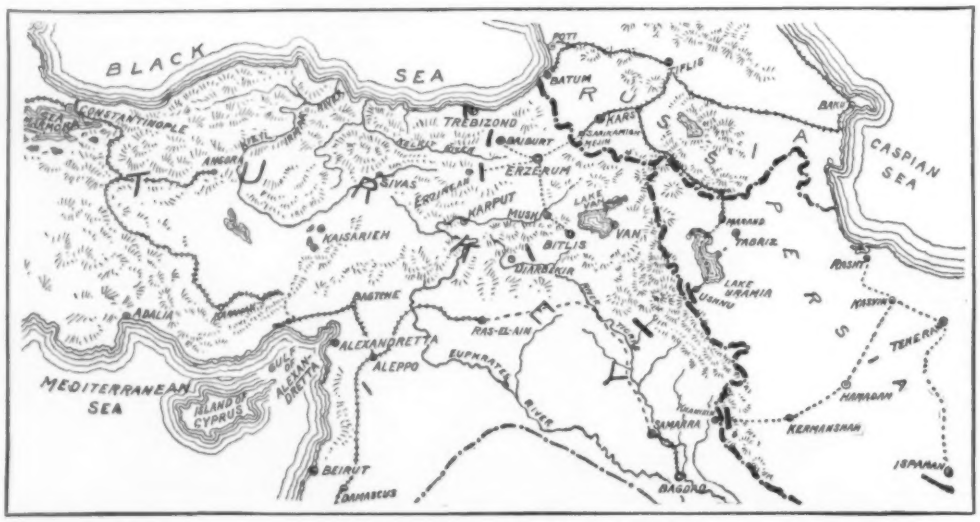
The capture of Trebizond should assist the solution of future Russian problems of transportation and supply in the vicinity; and for purposes of supply in that dreary section, a vicinity may well be 150 or 200 miles. Roads and facilities are as scarce as that, for main avenues of communication.

In the earlier days of operations, the maps showed that the nearest railhead to the theatre of war was at Kars, in the southwestern corner of Trans-Caucasia; later maps, however, show that the railway had been extended to Sarikamish, almost on the Turkish border. This point, then, constituted the main base of operations and supply.

From Sarikamish, good (?) roads lead to Erzerum. Its fall rendered the establishment of an advanced base there feasible. From Erzerum, the line of communication extended to Baiburt, 50 miles south by east of Trebizond. Russian troops are operating in this vicinity at the present time. The line of communications to the Erzingan locality, in which Russian troops also are operating, came through Erzerum.

From Erzerum, a detached base was established at Mush, which point also draws supplies over indifferent roads from lesser places. From Mush, the distribution continues in the direction of Karput and Diarbekir. Karput is close enough to the Eastern Euphrates to be served to a certain extent by that river as a line of supply; Diarbekir must rely entirely upon roads over which wheeled transportation plays.

Bitlis, on Lake Van, may count to a certain extent upon Mush for a line of communications, but there is another feasible avenue which, though tortuous, extends through the Khan-i-Sur pass northwest of Lake Urmia,



Progress of the Russian armies in Turkey and Persia

to the railroad at Marand, 40 miles northwest of Tabriz. To avoid congestion of supplies and transportation, trains may be run this far on the road from Tiflis, which was projected to extend to Teheran, in Persia.

Southwest of Lake Urmia, Ushnu enjoys almost an opulence of position, for it is little more than 125 miles to Marand. Lake Urmia itself offers opportunity for forming a long link of rapid water transportation between two short hauls, at each end of the line. This place, an important road junction, must supply any forces operating in its vicinity with comparative ease.

The situation in southern Persia is far more difficult. The Caspian Sea must constitute the most feasible route for the forwarding of supplies. Landed at Rasht, in a wonderful protected harbor, they can be forwarded by road to the valley of the Kizil Uzen River and to Manjil, thence to Kasvin, which is a most important junction, long since in Russian hands.

From Kasvin, Teheran is supplied; from Teheran, Ispahan. And the main avenue of advance through Persia is also based on Kasvin primarily, for from it extends the road to Hamadan and Kermanshah, as well as to the Khanikin Pass on the border.

Names mean little in mere black and white, but it is impossible to describe the situation otherwise. It will well pay any student of the war to obtain a large map of this section and minutely examine it. It will disclose some hint of the vastness of the problem with which the Grand Duke has wrestled; and it will then be no violation of neutrality to agree that his progress thus far has been a marvel of scientific military accomplishment.

The fall of Trebizond is of no particular moment, more than the gaining of another city and control of a little more territory. Its capture has seemed imminent for some time for, with Russian domination of the Black Sea, the assistance of the navy rendered the result comparatively certain. Reports to date fail to indicate the capture of any considerable body of Turkish troops, for though it is reported that three divisions, totaling some 50,000 men were in occupation, there is no report of their taking. With the sweep of Russian forces to the southward of Trebizond they would have been in imminent danger of isolation, and they evidently had plenty of time to retire towards the general line of defense which lies well to the westward, toward Sivas and the Irmak.

Northeast of Sivas, the Kizil Irmak River from the south, and the Kelkit River, a tributary of the Yeshid Irmak which empties into the Black Sea, form a salient eastward about 70 miles from the Sivas line. These streams promise to form a difficult line to be assaulted, for neither can be turned, as they approach each other within twenty miles at the apex of the salient. The country closely enfolding them is mountainous and forbidding, and it is unlikely that any determined stand of the Turkish forces will be met by the Russians until these promising lines are approached.

The Grand Duke has accomplished wonders from a military standpoint; but his hardest work lies before him, for the troops which oppose him are just beginning to reach their chosen country for defense; and the outcome is on the lap of the gods.

Fish and Eggs Distributed by U. S. Bureau of Fisheries

FIGURES showing the distribution work during the month of February, 1916, have been made public by the United States Bureau of Fisheries. These covered the species and the total number of fish and eggs. The figures are: Black bass, 43 fingerlings; brook trout, 5,000 eggs; chinook salmon, 1,802,500 eggs, 7,197,000 fry; cod, 40,248,000 fry; crappie, 2,350 fingerlings; dog salmon, 450,000 fry; flatship, 395,479,000 fry; humpback salmon, 339,000 fry; lake trout, 826,054 eggs; pollack, 128,504,000 fry; rainbow trout, 573,400 eggs, 20,500 fingerlings; rock bass, 500 fingerlings; silver salmon, 196,000 eggs, 94,000 fry; sunfish, 9,325 fingerlings; warmouth bass, 150 fingerlings; yellow perch, 110 fingerlings; total to end of month, 3,402,954 eggs, 572,311,000 fry, 32,978 fingerlings.

The stations from which the distributions were made, and the species from each were: Baird and substations, chinook salmon; Baker Lake and substations, dog, humpback, silver salmon; Boothbay Harbor, pollack; Central Station, humpack salmon; Clackamas and substations, chinook salmon; Cold Springs, sunfish, warmouth bass; Duluth, lake trout eggs; Erwin, rock bass, sunfish; Gloucester, cod, pollack; Green Lake, land landlocked salmon eggs; Leadville, brook trout eggs; Manchester, rainbow trout eggs; Neosho, crappie, rainbow trout, sunfish, yellow perch; San Marcos, bass crappie, sunfish; Woods Hole, cod, flatfish; Wytheville, rainbow trout.

Scarcity of Wood Pulp in Spain

THE shortage in the supply of wood pulp for paper manufacture in Spain and the high prices now demanded for this product is causing some anxiety among paper manufacturers and publishers. The daily press will probably be obliged to reduce its consumption of paper. Attention has been given to the advisability of the government's undertaking to stimulate the cultivation of the poplar tree, the wood of which is preferred for wood pulp in Spain.

Spain imports almost all the wood pulp required for its paper industries and exports to England much of the pine grown in Galicia, which is highly resinous and not so well suited for paper manufacture as the less resinous pine of Sweden and Norway. Experiments, however, are to be made to ascertain if, by extracting the resin, native Spanish pine can be used, at least as a temporary substitute. Most of the local paper mills, it is stated, can not employ rag and jute wastes, their plants being adapted to wood and chemical pulps. Nearly all the waste material such as fiber waste, rags, and bagging are exported, the United States having become, since the war, the leading customer.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Denatured Alcohol as a Substitute for Gasoline

To the Editor of the SCIENTIFIC AMERICAN:

I have been much interested in your recent articles on industrial preparedness, and those articles relating to the work of the U. S. Bureau of Commerce, but I have been more particularly interested in the statements about the petroleum industry, an industry whose product, in our present complex business life, seems to be of the very greatest industrial importance.

I am more particularly impressed with an omission in the articles referred to than to anything that you have printed, an omission of the proper presentation of the facts, figures and possibilities of the denatured alcohol industry whose product must ultimately be of very great economic worth.

This branch of industry has been dismissed with a few words, and, at that it received more recognition than seems to be accorded it by the current agricultural and technical press of the country.

The growing scarcity, measured by the demand, of the lighter hydro carbons for fuel for use in internal combustion engines is being very forcibly impressed on our people by the marked increase in the price of the usual fuel, gasoline, and the daily press is filled with angry protests directed at those who produce this commodity, one very prominent automobile manufacturer being reported as enlisting his efforts and his millions to correct the tendency of this necessary motor fuel to rise to a prohibitive figure, thereby affecting the motor vehicle industry in which he is interested.

In all of this outcry we see no reference to the fact that denatured alcohol may be used as a substitute for gasoline, and no reference to any possibility that the alcohol may be produced at a figure that will cause it to displace the present fuel.

Our people seem to have settled down to the belief that alcohol must always remain high priced and will not likely be used as a substitute for gasoline until this latter fuel reaches a very high price, and we seem to have accepted the statement that the products from which alcohol is made have a greater value as food for man and beast, at anything under the present price of denatured alcohol.

I, as a user of motor fuel, have pondered over this matter and have thought that we should adopt the plan of cultivating the sugar beet for the production of alcohol as they do in Europe, but when you consider the average American farmer, one must conclude that this crop as a source of alcohol is out of the question, for the aforesaid farmer will not put the hand work into a crop that the production of the sugar beet requires.

But there is a crop from which alcohol can be produced, that the average American farmer can grow according to his inclinations and traditions and that is the saccharine sorghums.

Some years ago the U. S. Department of Agriculture spent much money and made a very creditable effort to develop the production of sugar from sorghum, but from what I can remember, it was determined that the juice of this plant contained certain glucosids that prevented the crystallization of the saccharine matter and in the then known state of chemical knowledge, the hope of adding the production of sugar to the general agricultural industry of the country was abandoned.

It seems to a layman that the production of alcohol from sorghum would be an ideally simple matter: a machine of crushing rolls with a small stream of water trickling on them, a further diffusion of the crushed stocks in vats of tepid water, a maintenance of the sweetened water at the proper temperature and the addition of the proper ferment, the distillation of the liquid when the alcoholic stage is reached and the addition of the denaturing substance, a process that might be carried on by comparatively unskilled labor.

I have never seen any figures on the production of alcohol from sorghum, but have been informed that an acre of sorghum will produce from 60 to 100 gallons of syrup.

The American farmer will cultivate this crop because it involves no new kind of labor, no hand work until the harvest, and I am not sure that for the production of alcohol there need be very much hand work then, as the necessity for stripping the leaves very carefully, would not be present if alcohol instead of syrup were to be the product.

The farmers of this country are becoming very large users of hydro carbon fuels for power, for cooking, and for the motor vehicle of which nearly every one is an owner or prospective owner, and the more general use of farm tractors will certainly be curtailed unless a low priced fuel suited to their needs is found. It is the most logical and economical proposition for the farmer to produce this fuel himself, and the successful production of sorghum grown alcohol will find each farm equipped with a large steel tank for the storage of this liquid.

We have immense areas of land particularly adapted to the growth of sorghum, the great southwest, Kansas, Arkansas, Oklahoma, Texas, are states to which this crop will be better than gold mines. The sorghum plant is well suited to the states named as they are sometimes subject to dry weather conditions that make the production of some other crops uncertain, but in all of the corn states and the South generally, this sorghum plant is at home and could produce immense quantities of alcohol.

In our present more advanced state of chemical knowledge it may not be impossible to convert the compounds in the sorghum syrup that prevent its crystallization, by some catalytic or other chemical process, as in the hydrogenation of the oils to produce the more solid fats, and thereby add sugar production to the list of products of the sorghum plant.

Some of our agricultural experiment stations, should this season, plant small tracts of the saccharine sorghum and convert the juice into alcohol and secure data that may be useful to those who may wish to cultivate this crop for that purpose.

It seems to me that there is no better way to bottle up or store away for future use the sun's rays during the superabundant season than to grow this saccharine sorghum, and I believe that when the full possibilities for the production of alcohol from this plant are properly appreciated by our people it may well justify the prediction that our present vitally important petroleum industry may in ten years from now be relegated to a position of subsidiary importance.

STANLEY PIKE.

Greenfield, Ohio.

Nature's Mathematics

To the Editor of the SCIENTIFIC AMERICAN:

Dr. Russell in his recent article, "The Heavens in April, 1916," states: "Dr. Lowell . . . argues further that the canals form so remarkable a geometric network of fine, sharp straight lines that they cannot have arisen from the casual operation of natural forces, but must be artificial, and the products of great engineering skill"—a statement borne out by others in regard to Dr. Lowell's sensational proclamation in regard to the planet Mars.

The honey-bee constructs hexagonal cells in which to store honey—mathematicians agree that this is the most satisfactory arrangement where economy of space and material is the object. We might cite also the definite arrangement of leaves on the stems of most plants. Granting intelligence to animals and plants, such results are not due to "the casual operation of natural forces."

In the inorganic world, there is, if anything, a greater number of examples of nature's mathematical ability. We are told that the planets of the solar system are proportionately spaced. Is there no mathematics in the unvarying molecular composition of chemical compounds? To most men the geometry of crystallography is amazing and mystifying.

Apropos of the geometry of the Martian canals—most of us have seen mud-flats from which the water has all evaporated, leaving surface exposed to direct rays of the sun. Mayhap we have wondered at the often perfect geometric figures formed by the mud-cracks. Mars is a dead, parched world. May we not compare it with the dried-up mud-flat, and the canals with the cracks?

Is it true that nature never works with mathematical economy and precision?

ROSS E. BOWERS.

Erie High School, Erie, Pa.

A Marked Divergence of Opinion

To the Editor of the SCIENTIFIC AMERICAN:

Be so kind and discontinue my subscription. As much as I like your paper, I am sorry to be bound to discontinue it. Why cannot at least a "scientific" paper of your standard remain really neutral in this sad war?

Your first two military experts were really good and up to facts, while your present one is not only deficient in history, but even in geography. It's disgusting to notice that even "scientific" papers should permit themselves to be blinded by prejudice to the extent of printing some of the things you did, for example, that German officers should have believed that England was fighting with Germany instead of against it, and the like.

Yours truly, with regret,

(REV.) BEDE MAYENBERGER.

Freeport, Minn.

To the Editor of the SCIENTIFIC AMERICAN:

Enclosed my subscription for another year of the SCIENTIFIC AMERICAN. I had meant to attend to this matter before, but overlooked it through carelessness. You may begin with this week's issue, for the present subscription, or if more convenient, send the back numbers which I have missed.

Let me take this opportunity to thank you for the exceptional sanity, clearness and fairness of all your articles dealing with subjects related to the war, in such refreshing contrast to the almost universal biased tone revealed by other journals. What I appreciate even more, however, are the instructive and clear-visioned articles dealing with the naval and military, as well as industrial preparedness of our country. They should be read and taken to heart by every good citizen of the U. S. A.

With the best wishes for success, I beg to remain,

Very truly yours,

EMIL J. SCHMIDT.

Chicago, Ill.

Why Does Not the Submarine Give Submarine Warnings

To the Editor of the SCIENTIFIC AMERICAN:

If the sinking of merchant ships without warning continues the United States may be drawn into war.

If the submarines give warning by rising to the surface they would be sunk if the warned ship happened to be armed.

Some years ago there appeared in your columns an account of a submarine bell to warn ships of the presence of other ships in fog. Could not this bell be used by submarines to warn merchant ships to stop and thus solve the submarine problem?

Could not wireless also be tried?

F. A. DE PEYSTER.

11 E. 86th St., New York city.

Wanted—A Substitute for Steel Poster Panels

To the Editor of the SCIENTIFIC AMERICAN:

You are respectfully advised that the members of the Poster Advertising Association consume large quantities of galvanized steel in the erection of poster advertising structures throughout North America. These structures are built in 25-foot panels, 11 feet high, upon which are displayed posters advertising various commodities and industries. The steel surface upon which the paper is posted is quite satisfactory in many respects, but the steel is very expensive and being exposed to the elements deteriorates very rapidly. An ideal posting surface should be smooth and rigid and yet very light, so that the faces of the panels could be easily taken down and moved to new locations.

The purpose in writing you is to call the matter to your attention and if possible to secure from you information as to where a desirable substitute for the steel panels might be secured. Perhaps some of the wall board manufacturers could help in this direction, if they could render their commodity water proof so that it could be used when exposed to the elements. As there are already in the United States probably a million of these panels, you can readily understand that a large market awaits a manufacturer who can fill the need.

E. ALLEN FROST.

Chicago, Ill.

German Products in American Markets After the War

To the Editor of the SCIENTIFIC AMERICAN:

The idea seems to prevail that after the war the United States will be flooded with cheap German products. Germany first secured a market here by selling goods made by cheap and abundant skilled labor. Laborers, both skilled and unskilled, are being killed in vast numbers. After the war the scarcity of skilled labor and the heavy taxes which the remainder must pay will make higher wages imperative. Will this not necessarily increase the price and lessen the quantity of goods for export? There will also in some quarters be a prejudice against German products which will limit the demand, and importers will be slow to buy goods which they cannot sell. May not these conditions prevent the anticipated flood of cheap German goods?

H. N. ROBINSON.

Hartford, Conn.

Forest Wealth of Morocco

THE preservation and exploitation of the forests in the French zone of Morocco are in charge of a special governmental department, which has given particular attention during recent years to the working of the cork forests of Mamora. These cover more than 500 square miles between Rabat and Mequinez. The bark is harvested by natives under the supervision of foresters brought out from France. It is expected, states the *Board of Trade Journal*, that this forest alone will produce a revenue of some $800,000 within five or six years. There are a number of other smaller cork-oak areas in the region, and in other districts there are valuable stands of thuya, cedar, oak, pine, maple, juniper, yew, and argan. Some of these are of great extent and contain magnificent trees, more especially cedars and oaks.

Mexico: Its Political Situation, Its Resources, and Its Military Strength

THIS article, a plea for better understanding, has been prepared by one who served in the Army during the Spanish and Filipino Campaigns, and who was later connected for years with the Civil Government of those islands. He has lived also among the Mexican people and has made a deep study of that country's condition as a parallel to that existing during the first six years of our oriental colonial experiment in the Philippines. EDITOR.

THE total area of the Republic of Mexico is only slightly less than that of our states east of the Mississippi, not including Florida. The terrain is varied. Both on the east and the west are great mountain chains paralleling the coast; these unite at the Isthmus of Tehuantepec and form a single ridge which continues on the western coast to Panama. From the isthmus to an east-and-west line somewhat north of Mexico City there is what might be called a jumble of mountains with intervening valleys, most of which are highly fertile and well watered, a few being barren sand.

Between the two main mountain chains from the Rio Grande to the foothills north of the capital is a triangular shaped plain rising on a gradual slope to the southward. With the exception of an occasional river bed, this plain is a desert.

The climate of Mexico is governed more by elevation than by latitude. On the coasts and over the entire Yucatan Peninsula it is that of the tropics. There are seasons of almost continual rain, the occasional bursts of sunlight causing the entire country to steam. During the winter months the climate of the coast states is exceedingly pleasant.

Over the great central plain the climate is that of southern New Mexico and Arizona. The lower latitude makes the heat of the sunlit hours more intense; the greater altitude results in generally colder nights. Farther south, in the densely populated Federal District and its surrounding states, the elevation, combined with the latitude, result in a climate unsurpassed by that of any district in the world.

Of the people of Mexico, at the last census something over fifteen millions, it was estimated that 20 per cent were of pure Caucasian blood. The remaining 80 per cent was about equally divided between Indians and mixed-bloods. It is probable that the disturbances of the last four years have materially lessened the percentage of pure whites. About 50 per cent of the people are illiterate.

Excepting in the sections where foreign capital has intervened, in the cities and on the great estates of the hacienderos, the methods of life are most primitive. The country as a whole may be said to be practically undeveloped. In some sections there are tribes of Indians who have never been reduced to subjection, though during the last of the administration of Diaz they were nearly so. Such progress as has been made has been due almost entirely to the encouragement given by Diaz to foreigners to open the country and to the peonage system of compulsory labor. This last, however, was largely responsible for Diaz's enforced retirement.

Compared to the United States, there are very few railroads, and most of these are government-owned, their revenues, however, being heavily pledged. Four lines leave the border, the most easterly ending at Tampico, the most westerly at Guaymas, and the two central running to Mexico City and thence to Vera Cruz and the Isthmus of Tehuantepec. There are several branch lines tapping the rich and thickly populated states in the vicinity of the capital, and a single line crosses the Isthmus of Tehuantepec and continues south to the Guatamalan border.

Good wagon roads are almost unknown except in central Mexico. Prior to the railroads the old "camino real" from Mexico to Vera Cruz was well maintained, but when the railroad relieved them from the necessity the Mexicans permitted it to fall into disrepair, and now many sections are passable only for pack animals.

From the foregoing it will be plain to the military reader that the control of Mexico presents to-day the same problem, substantially, that it presented a century ago. It calls merely for the occupation of the coast cities having railroad termini, and of the main routes of travel. This places in the hands of the forces occupying these points and routes all the commerce and practically all the resources of the country. Nor does the occupation need to be so extended. If the shaded sections of the map were securely held, the absence of roads of any kind would permit little communication and no effective coöperation between the sections of the country separated, which could then be taken, one by one, and reduced in detail if necessary or desirable.

Each subdivision would be entirely dependent upon its own resources, not only for the daily necessaries of life for its inhabitants, but for the munitions to continue a campaign of resistance. Nothing could enter the country from abroad, especially if a reasonably effective naval blockade were established. The occupation of the Isthmus of Tehuantepec would cut off any aid through Central America. Nothing would remain for the Mexicans except a guerilla warfare, more injurious, probably, to their own nationals, who would be exploited for the control of the several bands, than to the occupying army.

These facts illustrate the hopelessness of the present strife in that unhappy country. Lacking a cohesive people and a common objective, with transportation facilities unequal to the rapid mobilization and movement of an army of decisive size, it appears impossible for any one political party to subdue all its opponents, unless the funds necessary for the equipment and support of a large army are made available; and the longer the struggle continues the less able are the people to stand taxation.

Cavalry parading in Mexico City. These represent the troops organized along modern military lines under Madero and Huerta

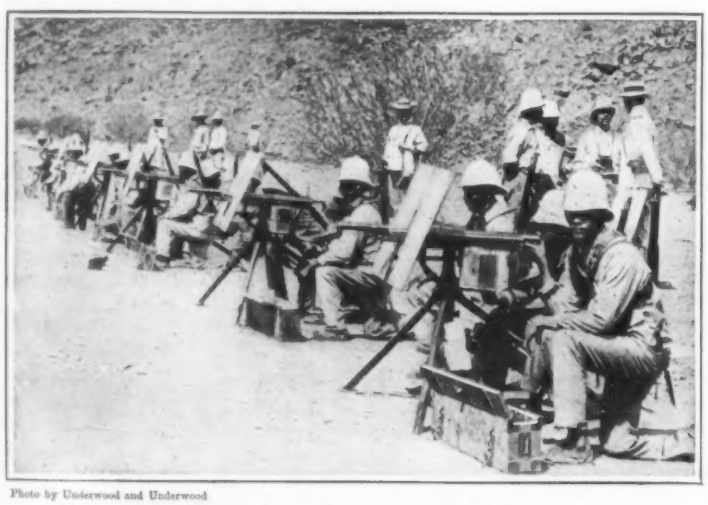


Photo by Underwood and Underwood

A rapid-fire squad of Constitutionalists

The Mexican Army under Diaz was fairly efficient. He established military zones under control of divisional troops, and raised a force of rurales which gave valuable assistance in obtaining information and in acting as guides for the regular troops. He established military schools, in which the officers were well prepared for their duties. His army was comparatively well equipped and was thoroughly disciplined. All branches, infantry, cavalry, field artillery and engineers were represented, though not in the proportions best adapted for combined service. In all, he had about fifty thousand effectives.

The reorganization started under Madero and completed by Huerta was along modern lines. The military zones were discontinued and the army organized by tactical divisions. On paper it amounted to over one hundred thousand men; actually it never reached a number greater than sixty thousand, and these were inferior to Diaz's troops in every respect, the greater part of the soldiers being forced into the ranks, and a large percentage being of the criminal element. Doubtless, however, Huerta would have held his own in central Mexico had he been able to obtain the necessary arms and ammunition for his men.

The Carranza-Villa forces which overthrew Huerta were hard riders from the northern plains. The major portion of their troops were mounted infantry. They had a limited amount of artillery, but reports do not indicate that either the Federals or the Constitutionalists could use this arm effectively. And there was no strategy in their conduct of operations. These partook of the character of minor tactics, the operations of the next day being based upon the success or failure of the present day's action. Zapata, the independent bandit ruler of Morelos, also was a thorn in Huerta's side.

With the departure of Huerta and the following rupture between Carranza and Villa, there was again a dissolution of the armed forces. The major portion of their joint army remained loyal to Villa, who was the idol of the rough and ready adventurers, while the remnants of the old Diaz army and Huerta's federals stood by Carranza, at least half heartedly. But the fortunes of the First Chief were at a low ebb, and had Villa possessed the same genius for organization that he had displayed as a leader of irregular troops, he might have

Photo by Underwood and Underwood

A twelve-year-old Mexican soldier

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Mexican field artillery being moved into position

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Stopping for a bite to eat

eliminated his former associate.

Fortunately for Carranza, he had the wit to appreciate the ability of the only true military genius that the four years of strife had developed among the Mexicans. General Obregon, young, energetic, fearless and, in spite of many temptations, loyal, has succeeded in uniting the scattered fragments of the armies of the several different governments into what appears, at least, to be an effective whole. In spite of initial defeats, he forced the opposing faction to withdraw from the Federal District, and then in two pitched battles, routed the Villa forces and destroyed the bandit chief's reputation for invincibility. And he has consolidated his advantages in the sections his forces have occupied. It is his army, estimated at about forty thousand men, all accustomed to campaign, that forms the military strength of Mexico to-day. It is a very small force for the territory to be policed; its organization would cause a military man of Europe to smile. The equipment is what they can get. There are field guns from France and Germany, rifles from Germany, from Spain, and from different factories in the United States, machine guns of equally varied models, while the commissariat is what the women camp followers can buy or forage from the country and cook for the men after the day's march. That Obregon has been able to accomplish the results he has is remarkable.

It has been said, and with truth, that every adult male Mexican is a bearer of arms. The country has been likened to an armed camp. But only uniformity of equipment can make a dependable army. The day of the hastily-gathered volunteers, each bringing his own weapon, passed a hundred years ago. The country is not self-supporting when it comes to munitions. There are four factories in the neighborhood of Mexico City, two for small arms ammunition (and these for the Mauser rifles with which the army was formerly equipped and most of which must be worn out), one for field artillery ammunition, and the fourth practically a repair shop. All are of limited capacity and dependent upon machines and materials largely imported.

Map of Mexico showing, shaded, the areas which possess any military importance

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Mexican Federal Cavalry on the march near New Laredo

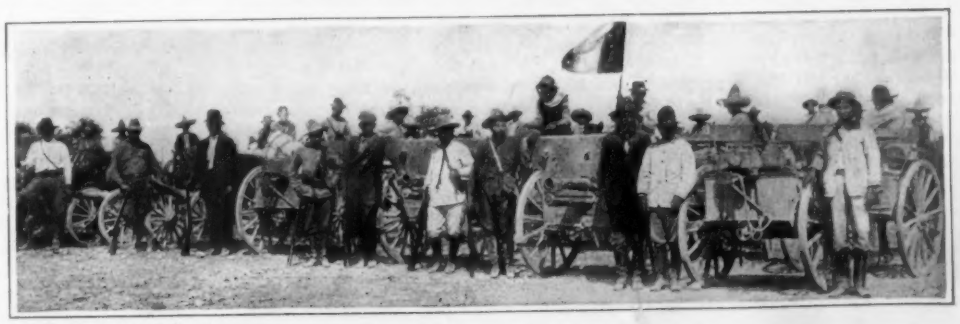


Photo by Underwood and Underwood

A Mexican battery of light field guns

Should Mexico become involved in a war to-day, a war which would cause the cessation of shipment of arms and ammunition from the United States, the inevitable end could be easily anticipated. It Is certain that during the past two years she has received nothing from Europe, which has needed its entire output, and it is equally certain that the supplies she has received from this country have been insufficient to make up for the wastage of even such sporadic campaigning as the contending forces have undertaken. Small arms deteriorate rapidly in war. The Mexican soldier is prone to shoot away ammunition freely, and this, especially when the rifle is not cleaned intelligently and immediately, results in rapid erosion of the bore and increasing inaccuracy. The small number of casualties in their various "battles" may be due as much to inaccurate weapons as to poor marksmanship and discipline. After a few reverses, in which the arms of the dead, the wounded and the panic-stricken were abandoned on the field, it is doubtful if the Mexicans could put in service, all forces combined, a properly equipped army of the size now serving under Obregon.

The country is highly favorable to the defenders, but only for a delaying action. The occupation of the coast cities is, as shown by our own Vera Cruz experience, a simple matter. They have no harbor defenses worthy of the name, and no navy. The seizing of the Isthmus of Tehuantepec is little more of a problem if undertaken simultaneously from each coast. To penetrate from Vera Cruz to

(Concluded on page 456)

The Heavens in May, 1916

The Great Globular Cluster of Stars in Hercules

By Prof. Henry Norris Russell, Ph.D.

FOR two or three months past we have devoted our attention in these columns largely to the planets. It is high time now to turn to the stars, and consider some recent work that has been done upon objects incomparably more remote than any of our planetary neighbors.

In the constellation Hercules, on the line joining the bright stars Eta (η) and Zeta (ζ) (which may be found upon our map) and about one third of the way from the former toward the latter, may be seen a little, hazy speck of light. The unaided eye on a dark night can just detect its existence. With a field-glass one can see two small stars, and near them a diffused luminous mass, looking somewhat as the Præsepe cluster does to the naked eye, but much smaller.

With a fair-sized telescope—say of from 6 to 10 inches in aperture—this mass is "resolved" into a great globular cluster of stars—very faint individually, but so exceedingly numerous as to present a magnificent spectacle. With the greatest telescopes the cluster is a most impressive object—the whole field of view being strewn thickly with countless points of light. Photographs of long exposure, such as have been obtained with some of the larger reflectors, show even more, and reveal a globular aggregation, densest at the center and fully 15 minutes of arc in diameter, containing about 50,000 stars brighter than the 21st magnitude (that is, than the faintest stars which can be photographed with the great Mount Wilson reflector in six or eight hours' exposure), and probably many more still fainter stars.

It is therefore clear that we are dealing with a most remarkable object, and many questions present themselves to be answered—if we can.

Are these luminous points, so closely crowded into one little area of the sky, really stars like those which are more sparsely sown in space near us? Is each individual one among them a *sun?* And, if so, are they as big and bright as our own sun? How far apart are they from one another? And at what distance from us?

Answers, in part at least, to these inquiries are now possible, though even two or three years ago they would have seemed quite out of reach.

The first contribution was made by Fath, who photographed the spectrum of the light of the cluster and found that it was of the ordinary sort, crossed by dark lines, showing that the source of the light was really in star-like bodies of constellations essentially similar to the sun's.

Later spectrograms, made at Mount Wilson, showed the spectra of a number of the individual stars, which were found to be of various types—ranging from that of Sirius to that of the sun—but all quite similar to those which are found among other stars.

Like the nearer stars, the members of the cluster differ also in color—as was first shown by Barnard by comparing photographs taken on ordinary and isochromatic plates. This matter has very recently been made the object of an extensive study by Shapley at Mount Wilson, with important results. He finds that the range in color among the cluster stars is extensive—as great as is found among the stars visible to the naked eye. Some of the members of the cluster are as blue as the stars in Orion, while others are as red as Aldebaran or even Antares, and all intermediate colors are represented. From this fact alone conclusions of much interest may be drawn. It has been supposed by several investigators that there exists a minute absorption of light in space, of such a nature that the blue light is weakened more than the red. If this is so, the remoter stars should appear redder the farther off they are, and in this cluster, which is undoubtedly very remote, those stars which, if nearer us, would be bluish-white should look yellow, those which would otherwise be yellow would seem red, and those naturally red would have their redness greatly exaggerated. That is, while the stars would still appear to differ from one another in color, the range of color, instead of being from bluish-white to red, would be from yellow to excessively red.

Nothing of this kind is found by observation; and it is therefore rendered very probable that, in the direction of the cluster at least, there is nothing in space to absorb one kind of light more than another.

Another deduction is of still greater interest to the general reader. It is found that the brightest stars are all red or orange. On passing to those a little fainter many white stars are found, and among those fainter yet, of the 15th and 16th magnitudes, all the stars are white, or, at most, yellowish, in color.

Now among the stars whose distances we can measure and whose real brightness we can calculate, it is found that some of the very brightest are red—for example, Antares, which is in reality about 3,000 times as bright as the sun. Among the stars of brightness 20 to 100 times that of the sun, however, the great majority are white. Stars ten times as bright as the sun are likely to be yellowish, and those of the sun's brightness, like the sun itself, are yellow, while the still fainter ones are orange and red.

It is only among the stars of greatest real luminosity—100 times that of the sun and more—that stars of all colors and of the same brightness may be found. This makes it very probable that the brighter stars in the Hercules cluster, which show a similar wide range in color, are also objects of great real brightness, and that those somewhat fainter stars which are almost all white are comparable to Sirius and Vega.

If this is true, the distance of the cluster must indeed be enormous to reduce such brilliant stars to their apparent inconspicuousness. Data are not yet available for a precise estimate; but it appears that the distance must be of the order of magnitude of fifty thousand light-years, or 3,000 million times the distance of the sun.

This makes the cluster a really stupendous affair—fifty thousand stars, all brighter than the sun, and the brightest ones exceeding it more than a thousand-fold, scattered through a region some 200 light-years in diameter.

Within a similar distance from the sun there are probably much less than one tenth as many stars of equal brightness, so that the stars must be much nearer one another in the cluster, especially in its denser central positions, than in the region of space in which our system lies. Even so, they would not be embarrassingly close neighbors, being separated by tens of thousands of times the distance which divides us from the sun. In all probability the individual stars are moving, each in its own orbit, around the center of the swarm as a whole. A simple calculation shows that if this is so a single circuit would take more than a million years—so that it is not surprising that no relative motion has been detected among the stars of the cluster in the decade or two since the first accurate photographs were obtained.

At 11 o'clock : May 7.
At 10½ o'clock : May 15.
At 10 o'clock : May 22.

At 9 o'clock : June 7.
At 8½ o'clock : June 14.
At 8 o'clock : June 22.

At 9½ o'clock : May 30.

NIGHT SKY: MAY AND JUNE

The Heavens

The region of the sky about which we have been speaking may be found on our map east of the zenith and one third of the way from the bright star Vega—the brightest object in the northeastern sky—towards Arcturus, which is high in the south. Below Vega is the cross of Cyprus—now lying on its side—and due east is Altair. In the southeast are Ophiuchus and Serpens, and farther to the right is Scorpio—its head well up, though the tail is barely rising. Above and to the right is Virgo, and lower down, close to the southern horizon, is part of Centaurus.

Observers in southern Florida and at points farther south may at this season see the Southern Cross, still farther south and a little west of the meridian, and the bright stars Alpha and Beta Centauri, farther to the east.

The huge sea-serpent, Hydra, stretches from west to south, low down in the sky, with the Raven perched on his back. Leo and Ursa Major are high in the west and northwest. Gemini and Auriga are setting below them. Cassiopeia is low in the north, while Ursa Minor and Draco are high above the Pole.

The Planets

Mercury is an evening star all through May, and is conspicuous in the middle of the month, setting at about 9:05 P.M. He is then in Taurus, about 21° from the sun, and looks a little brighter than Aldebaran. He remains easily visible till the last week of the month, when he begins to draw in toward the sun appreciably.

Venus is likewise an evening star, and is at her very brightest—more than ten times as bright as Sirius—and at the same time very far north—27° from the equator—so that she is as conspicuous as it is possible for her to become.

She has not been as prominent for eight years past, nor will she be so again until 1924. At eight-year intervals, however, the earth and Venus return to nearly the same relative positions, and the phenomena approximately repeat themselves.

The planet is high in the northwest after dark, and remains in sight until 10:50 P.M. She is very easily visible in the daytime if one knows where to look for her. Telescopically, she appears as a rather wide crescent, 26″ across from horn to horn at the beginning of the month and 41″ at its close. At the latter date the crescent shape can be easily seen with a powerful field-glass.

Mars is in quadrature with the sun on the 14th and crosses the meridian at 6 P.M. He is moving eastward in the sky from Cancer to Leo, and growing fainter, but is still brighter than Regulus.

Jupiter is a morning star in Pisces, rising about 3:30 A.M. in the middle of the month. Saturn is an evening star in Gemini, setting at 11:30 on the 1st and 9:30 on the 31st. On the 24th he is in conjunction with Venus, the planets being about 3½° apart.

Uranus is in Capricornus, visible before sunrise, and Neptune is in Cancer, observable in the early evening.

The moon is new at midnight on the 1st, in her first quarter at 4 A.M. on the 10th, full at 9 A.M. on the 17th, in her last quarter at midnight on the 23d, and new again at 3 P.M. on the 31st. She is nearest us on the 19th and farthest away on the 7th. During the month she passes near Mercury on the 3d, Venus on the 6th, Saturn on the 7th, Neptune on the 8th, Mars on the 10th, Uranus on the 23d, and Jupiter on the 28th.

PRINCETON UNIVERSITY OBSERVATORY.

April 18th, 1916.

Manufacture of Needles in England

IT is reported that at least eight concerns began to manufacture needles in England during 1915, and that the total production of needles in that country at present amounts to about 250,000 per week. To the lay mind it would seem that the output is out of all proportion to the possible demand; yet it is learned that the demand totals about 500,000 needles per week, hence the output is inadequate.

War Game—VII

The Decisive Attack, Enveloping Both Flanks of the Enemy

By Guido von Horvath

WITH the development of the combat, and the information constantly gained from small reconnoitering detachments, patrols in the service of information, the commander must make his decision on two important questions: *when* and *where* to deliver the decisive attack.

From the previous War Games it will be evident that in answering these two questions the time element is most vital. The deployment of a company can be made very easily and very quickly. It can be placed in position for fire action in an amazingly short space of time. When, however, it comes to larger bodies, to fronts extended wider than a mile, the maneuver for position for a decisive action may take several hours.

Therefore, in the present War Game, where the Blue detachment, commanded by Colonel K, is facing three battalions of Red infantry and one regiment of Red cavalry, on a front of over a mile and a half, some hours will naturally be required to bring about the necessary shifting of the troops of the First Infantry Brigade commanded by Brigadier General G.

The forces of the First Brigade gain the decision as far as the battle on Lookout Hill is concerned. But to bring about this result the brigade commander must make his decision far ahead, even before his own brigade is in actual touch with the enemy. He must direct his forces by every means at his disposal in such a way that the shifting of the troops should aid the teamwork of the other troops on the field of battle. He must time every movement to a nicety, and must be able at any time to know where every fraction of his command is located.

Above all, he must know when the decisive thrust must be delivered.

Therefore, the various columns composing the forces in hand must be directed, while still in their march formations, towards the positions in which they will have to act. Roads, railroads, boats and all other means of transportation must be utilized and every effort made to bring about these maneuvers with as much rapidity as possible.

The march of infantry is a slow procedure. In addition, marching saps the strength, and after a certain time diminishes the fighting capacity of the troops. In modern tactics the transportation of infantry by rail, boat, automobiles, or by any other means available, is a great factor. It offers rapid action and supplies fresh, dashing troops, and, besides, gives a chance to surprise the enemy.

In the problems offered in the present War Game we must consider the question of leadership. Up to the time when the First Brigade made its appearance, Colonel K was in command of the Blue troops. The order dated: "Norrisville, 7 June, 19—, 5:00 P.M., signed Brigadier General G," changed the situation in as far as the general developments are concerned. Until the receipt of this order Colonel K was free, in taking steps to accomplish the mission assigned to him, to make a move according to his own plans. From this time he must shape his plans to fit the orders of the brigade commander, who automatically takes command of the entire force.

The General's orders are that Colonel K shall hold his position. The arrival of the brigade will force a favorable decision. Colonel K's actions will be such as will assist the brigade in the accomplishment of its mission. With this goes the duty of informing the brigade commander of every matter which is deemed of value in promoting his plans.

For these reasons, at the first opportunity after the receipt of his orders, Colonel K should make an attempt to put himself in communication with his commander. Telegraph, wireless, telephone, signal or messenger service may be used.

We assume at 9:30 P.M., June 7th, Colonel K is in communication with Brigadier General G, and sends the following report:

Blue Detachment, Lookout Hill,
Southeast of Argus Farm,
7 June, 19—, 9:30 P.M.

To General G:

The enemy, with one regiment of cavalry, three battalions of infantry, and a battery, has a line extending west-southwest from Timcum Creek, and is in close touch with our defensive position. Enemy battery has been moved to right flank, behind wooded hilltop.

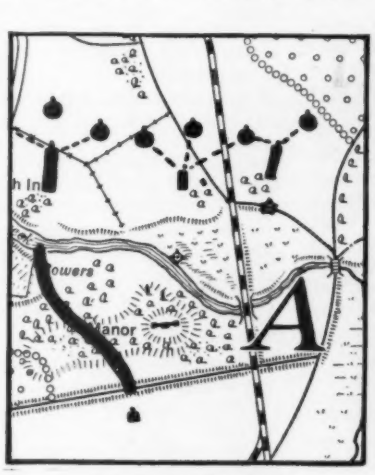
Layout of Timcum Creek and Green Lake region offers opportunity to cut enemy line of communication with their main forces and to completely crush him.

To afford quick transportation for two battalions of infantry, I have secured two river steamers and hold them at Railway Bridge southwest of Pottstown.

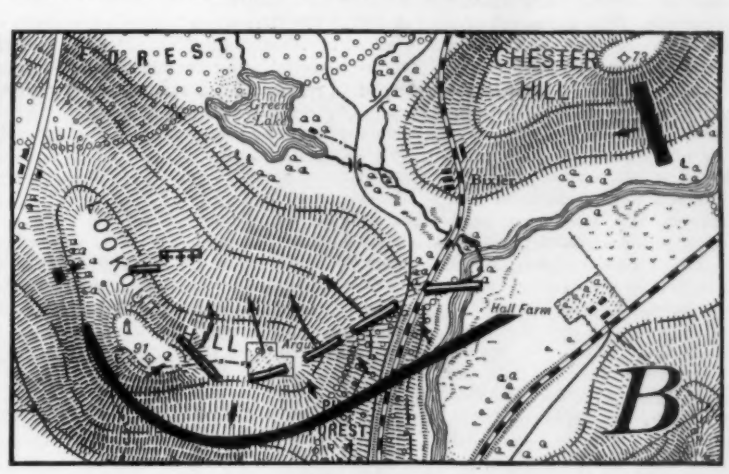
Platoon of Engineers is at northern edge of Pine Forest in readiness, with small boats to prepare landing farther upstream.

Diagram showing indirect firing

The gun at A can hit the gun at B by determining its distance and direction. The direction is determined by reference to an agreed visible point, "Aiming Point," instead of by reference to the points of the compass. In the profile, the Poplar Tree is the Aiming Point



Situation at 10:30 P. M.



Situation at 5:40 A. M.

I shall hold my present position on Lookout Hill.

K,
Colonel.

At this time the situation is as follows:

The advance troops of the Blues, Colonel K's detachment, did not succeed in defeating the Red advance troops, but on account of the distance between them and the Red main troops, the Blues have accomplished their mission of holding the Pottstown bridges.

A study of the terrain will give some interesting information. Since the advance of the Reds across the creek did not proceed swiftly enough to throw the Blues back and force them across the Nehaminy River, the left wing of the Reds, composed of the infantry battalions, is in a precarious situation, in view of the flanking attack of the Blue infantry brigade. The creek and the lake are at the back of the Reds. The only line of retreat for these forces in case of an overwhelming attack from the southwest would be across that single bridge. In case of such an attack it is very clear that a retreat would mean a disaster.

Had the battery retained its original position behind the Bixler buildings, it could have assisted the infantry in reaching the defensive line behind Timcum Creek, and eventually would have covered the bridge so as to enable these troops to retreat still farther to the edge of the Lebanon Forest. As it is, the Red commander must have plans of a different nature. These plans we shall see developed as soon as the action commences with the early morning light.

General Principles for a Decisive Attack

The first object of the commander and of the troops who seek to force a decision is to gain fire superiority over the enemy against whom they intend to deliver a decisive blow.

In the engagements of the two previous War Games Colonel K has apparently held back strong reserves, and has fought a delaying action. Before the surprise appearance of the Red cavalry on his flank his intentions might have been set on seeking a decision, but the developments of the combat changed his mind. From now on, however, it will be his duty to act with his whole strength toward this end.

The question of fire superiority, where well trained troops are engaged on both sides, is a simple question of number of rifles and supply of ammunition. Besides these two, fire direction becomes important. This latter is in great measure in the hands of the subordinate commanders, who must select their section of the enemy front and their proper targets. The commander's plan for the decisive attack will enlighten the subordinate commanders as to how and to what degree to apply the fire pressure on the enemy.

The character of the opposing commander, the enemy forces and their general fighting quality, and the terrain—all these must be weighed before the details of the action are communicated to the subordinate commanders.

It is evident that as soon as the commander has used up his reserves he has lost his influence on the action. This demands, as a matter of course, that a certain reserve, like a trump card, should be held in hand until the time arrives for playing it. Then, however, the reserves should be thrown into the action with all their decisive force. It is self-evident that whatever maneuvers may be made, preparatory to the decisive attack, they should be made as secretly as possible, and the cover offered by the terrain should be fully utilized. Feints and misleading actions designed to deceive the enemy are useful elements in both tactics and strategy. History records many brilliant exploits of this kind by great commanders.

The judicious use of artillery will very often enable the infantry to close in on the enemy with insignificant losses. Therefore, the greater the difficulties the infantry may have in approaching the enemy, the more fully developed should be the fire of the artillery.

The climax of the combat is the assault by the infantry, assisted to the very last moment by the artillery. The assault of the major part of the force should be concentrated upon one vital point. (See the explanation of the assault of a company of infantry in War Game III.) Success at the well chosen point means ultimate success at all points.

Application of Principles to the Present Game

The application of theoretical principles to the special case is always difficult. Before entering upon the discussion of the present Game, we shall consider certain distinctive phases, with their bearing upon the present task.

The present problem is to bring about a decision by means of the envelopment of both of the enemy flanks. This involves the march of the Blue Brigade on the Greenville road to a point from which a deployment to envelop the enemy's right flank will be most promising. This march is made at night. Darkness affords protection, but carries the danger of surprise

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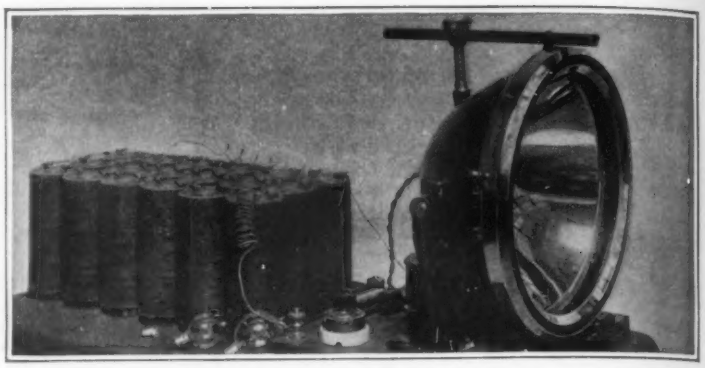
The music practice building for the students of the School of Music, Northwestern University, which contains 28 sound-proof rooms



The new form of triangulation signal lamp operated by dry cells, which is to replace the present acetylene type

A Building With Sound-Proof Rooms for the Study of Music

THERE has been constructed at Evanston, Illinois, a suburb of Chicago, a building which is believed to be absolutely unique—the first in the world of its kind. It was preceded somewhat over a year ago by a cheap, wooden experimental building which served to demonstrate the practicability of the ideas involved. The present building, however, is a handsome, two-story structure solely intended for the study of music.

Sound-proof floors, partitions and ceilings, forced warm-air ventilation, and hermetically-sealed doors and windows are features of the unique music practice building for the students of the School of Music of the Northwestern University. The novel features of the building have been evolved by Irving Hamlin, Secretary of the School of Music. The structure houses 28 diminutive rooms each measuring 6 by 9 feet, with ceilings 9 feet high. The rooms are eminently usable for music practice; their practicability, however, is only by reason of the peculiar construction of the doors—a patented invention—which prevents the transmission of sound from room to room, supplemented, of course, by sound-proof partition walls. In the existing music practice building of the school it had been found that a sufficient remoteness of one piano from another to furnish even a poor protection from the sound of a neighboring piano required rooms of at least 130 square feet of floor space. Comparing the latter figure with the 54 square feet of the rooms in the new building, the saving in building costs is at once apparent, while the sound-transmission is reduced to a minimum.

Four different methods of sound-proofing the partition walls have been adopted in different sections of the present music practice building, in order to learn their respective worth for future use in a larger music building which, it is hoped by the school authorities, may be built in the future. No lath or plaster appears in the building except in that section of the structure where gypsum blocks have been used, in which case a thin coat of plaster was applied merely to give the blocks a smooth surface. Otherwise, one-inch yellow pine sheathing has been used, covered with burlap; the latter in some instances is glued to the wall, and in others merely hung taut in the manner of tapestried walls.

The windows of the building are double; the inside window is hermetically sealed, while the outside one is hinged outwardly for convenience in cleaning. At a distance of 25 feet from the building, it is said that the 28 pianos when in use can hardly be heard, thus amply protecting the neighboring property from sound-intrusion.

Ventilation is effected by introducing air from out of doors at a point near the roof. It passes through a duct to the basement, through heating coils, through a spray, and thence by long individual pipes to the top of the wall in each room. A vent in the baseboard leads the air by an individual pipe to the attic where it escapes through a roof ventilator. The individual piping system prevents intercommunication of sounds between rooms. The entrance halls and corridors are heated directly by steam radiators, but the practice rooms receive all their heat, air and moisture through the ventilating system.

The music practice building is of mottled red brick, shingled roof, and is two stories in height, occupying a ground space of 28 by 59 feet. The interior woodwork is of birch in the natural color, the walls being covered with buff gray burlap. The doors simulate the so-called sanitary flush doors, two of that kind ⅞ inch thick being fastened together by means externally invisible with a ⅞ inch space between; the space in part occupied by sound-deadening quilt and in part by the hermetical sealing mechanism. The doors are so constructed that a downward push of the handle closes forcibly the crack between door and threshold, while the outer end of a finger, engaging with a cam, pushes the door unfailingly and forcibly against felt-mounted stop-mouldings at the top and free edge of the door; in a word, the door when closed practically makes the wall a continuous one. One fourth of the basement only is excavated for heating and ventilating machinery. The steam supply comes from the general heating plant of the University. The cost of the building was 19 cents per cubic foot.

Measuring Telephone Service With Meter Contained in Receiver

A TELEPHONE receiver has been invented by a resident of Webster City, Ia., which has as its main feature a special meter contained within the case and serving to register the actual time the instrument is in use. The receiver may be attached to any type of standard telephone equipment in a few moments' time.

The meter contained within the receiver case consists essentially of a size 16 seven-jeweled watch movement that counts minutes up to 9,999. When the receiver is placed to the ear, nothing is heard until a button located on the side of the receiver case is depressed. This winds the watch movement, starts it, and connects the instrument to the line; previously, the meter has been set by means of a set screw for any length of time from three minutes up to five minutes, and at the expiration of the time limit the instrument is disconnected from the line. If it is then desired to converse for a longer period, it is necessary to release the button and depress it again. The meter registers as low as one tenth of a minute, and the person calling up pays only for the length of time he uses the service.

It is believed by the inventor that the new meter will have a marked effect on the telephone service and conditions of the present time, since it is claimed that the use of the device will eliminate about 75 per cent of the waste of time in telephone traffic. Each telephone subscriber will be as brief and as business-like in his conversation as possible. The batteries of the telephone systems will always be in good condition because they will be used and not abused. As a whole, the changes that are expected as a result of the employment of the meter will, it is expected, result in making telephone systems—the metropolitan systems which have already reached a high state of efficiency are naturally exempted—many times more effective than under present conditions.

The New Triangulation Signal Lamp of the U. S. Coast and Geodetic Survey

By E. G. Fischer

THE state, county and city surveyors must look to the national government for the exact geographical positions upon which to base their respective surveys. The duty to establish and furnish these positions devolves upon the United States Coast and Geodetic Survey.

The geodesist determines astronomically with the greatest possible exactness the longitude and latitude of selected principal points, suitably distributed over the whole country. The geographical positions of the many places between these principal points required are ascertained most accurately and economically by means of what is called triangulation. A rough, preliminary or reconnaisance survey reveals those points which are intervisible and most desirable as to distance and other characteristics, to form the corners of connected triangles. From the measured length of one side of a suitably selected one of these triangles and the angles of all the interconnected ones, the exact latitude and longitude of each point is computed.

Though the general principle employed in the measurement of these angles is the same as that applied in the survey of a railroad, a farm, etc., the great distance between the points, varying between 10 and 100 miles and over, requires not only the use of specially large and refined instruments, but also a special means of making the point visible to the observer. This latter is now done, in day time, by reflecting sun light to the observer from a mirror placed accurately over the point, and at night by means of a specially constructed acetylene lamp.

It is apparent that distances of the magnitude mentioned can be penetrated by either means only under favorable weather conditions, and that many days during the season are lost even when the atmosphere is only slightly clouded by smoke, fog, etc. As the

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A House Built With Fifty-Six Varieties of Cement

THE Bureau of Standards is now conducting an interesting experiment in order to ascertain the wearing properties of various mixtures of cement. For this purpose there has been erected a long building the sides of which are composed of 48 panels, each panel about 12 feet in height by 14 feet in length, while the ends have each four panels; thus the entire building represents a total of 56 panels made of as many different varieties of cement. In each instance the composition is plastered into place in the same manner as it would be in common practice, and

(Concluded on page 456)

Telephone instrument of the desk type fitted with meter

Cement-testing house erected by the Bureau of Standards. The walls comprise 56 panels, no two of which are of the same cement

How the War Put *One* American Engineer to the *Proof*

Twenty months ago, probably not one business man in this country realized that certain well established ideas would shortly be put to the hardest test in history.

In the light of this war, the world that prided itself so on being *practical* turned out to be *full of theories.*

Nowhere in business activity has theory shown itself so strongly intrenched as in motor truck engineering.

Everybody had long foretold that the next war would be a *gasoline war.*

Everywhere in America it was assumed that in event of war an army could simply take over the output of *commercial truck builders.*

In the unsparing test of war service, this theory falls to the ground.

Heavy weight, constant work, the *unexpected,* were always showing up the weak spots of a truck.

But trucks like the Schnieder busses and delivery wagons of Paris, *built to meet war department specifications,* with a possible war in mind, are still running after nineteen months of war service.

It is logical that the engineer who designed the Locomobile, the *first American-built car* to win the Vanderbilt Cup, should also be the man to build the *American business truck that takes rank in war service* with the European trucks built to war department specifications.

This engineer is A. L. Riker, Vice-President and Chief Engineer of the Locomobile Company of America. Mr. Riker was first president of the Society of Automobile Engineers, and was chosen by his fellow experts of the Society to represent them on the United States Naval Consulting Board, of which he is Chairman of the Committee on Internal Combustion Motors.

A. L. Riker is an engineer who has always refused to be limited to the conventions of his science, and has insisted on living in *close contact* with the *business world and its problems.*

He began his intimate study of motor truck transportation in the business world in the early days of the automobile.

The trucks he designed and built fifteen years ago *are still running.*

Mr. Riker's latest achievement is the new Riker Truck, a *war-tested truck,* a truck developed from the lessons of the war, designed by A. L. Riker and built by the Locomobile Company of America—unquestionably and incontestably *the best built truck in America.*

For the first time in American industry, an engineer has provided for the business men of this country a motor truck designed to hold up in unsparing service and unexpected strains.

A truck that is good for *war service* is ideally good for *business purposes.*

The Riker Truck is the best built truck in America.

The Riker Truck has a frame of *chrome nickel steel,* as against the structural steel usual in truck practise.

Its engine bed is *government specification bronze,* instead of the aluminum ordinarily used. This is the only bronze engine bed ever put into a truck.

Its springs are of *silico manganese steel*—no better truck springs are made either in America or abroad.

Its transmission gears are of *chrome nickel steel,* its propeller shaft of *chrome nickel steel,* its driving axles of *chrome nickel steel.*

There is *more high grade material* in the Riker Truck than in any other truck built in America.

A Riker Truck *will go further, carry heavier loads, do its work* with *less tire cost, less upkeep and depreciation* than any other truck of the same rated capacity.

The price is about the same.

Engineers, Industrial Men, Superintendents of Delivery, Traffic Managers, Students of Technical Schools and Colleges, are invited to inspect the new Riker Truck, and see *Mr. Riker's application of engineering principles to motor truck design in America.*

The Riker Truck is on display at all our Branch Houses, located in the leading industrial centers of the United States as follows:

New York City	Sixty-first Street, next to Broadway
Boston, Mass.	700 Commonwealth Avenue
Chicago, Ill.	2000 Michigan Avenue
San Francisco, Cal.	230 Fulton Street
Philadelphia, Pa.	Twenty-third and Market Streets
Los Angeles, Cal.	Pico and Grand Avenue
Seattle, Wash.	600 East Pike Street
Cincinnati, Ohio	911 Race Street
Oakland, Cal.	Twelfth and Harrison Streets
Baltimore, Md.	107 West Mt. Royal Avenue
Washington, D. C.	1124 Connecticut Avenue
Pittsburgh, Pa.	Euclid Avenue and Baum Street
Kansas City, Mo.	1833 McGee Street
St. Louis, Mo.	3033 Locust Street
Minneapolis, Minn.	1416 Harmon Place
Bridgeport, Conn.	Seaside Park

LOCOMOBILE COMPANY OF AMERICA
BRIDGEPORT, CONN.

The New Triangulation Signal Lamp of the U. S. Coast and Geodetic Survey

(*Concluded from page 454*)

expense to maintain the party, which amounts to from $50 to $60 per day, goes on whether observations are made or not, it was thought that advances in illuminating devices, made since the lamp now used was adopted, might be utilized to increase considerably the intensity of the light directed to the observer, and thereby increase the number of observing nights.

Experiments made with calcium light produced by the oxy-acetylene flame showed this form of illumination to be impracticable by reason of the cost and bulkiness of the apparatus necessary.

The storage cell was studied with the view of using electricity as a source of light. Its cost and weight and the difficulties connected with its maintenance were found to be too great. The electric generator with the necessary prime motor was carefully studied, tried experimentally and found to be too heavy for transporting to difficult stations, and doubtful as to continued and unfailing service.

The result of a series of tests of dry cells, which are readily divisible into loads suitable for climbing difficult ascents, however, warranted the design and construction of two new lamps, the use of which, undoubtedly, will increase the present number of observing nights per month by at least 25 per cent.

The main part, an ordinary automobile headlight, is suitably mounted for directing in the horizontal and vertical planes; the lamp is provided with an ammeter, a small rheostat, and a switch. The whole, packed in a strong case, weighs 23½ pounds.

In order to obtain most nearly the maximum intensity of the light, it was necessary that the lamp bulb be provided with a filament concentrated to a degree not found in those on the market. One of the lamp manufacturers was induced to make the necessary designs and experimental tests, and submitted a number for trial.

At the present time all the lights of the stations surrounding the observer's station are kept burning continuously from sunset to the closing of the observations for the night. The use of the dry cell was found practicable and not too costly on the assumption that the proposed lamp was to be kept burning throughout the night. The trial of the newly designed lamp by comparison with the present acetylene lamp, however, proved the former so much superior that it was decided to have the lights shown only on signal, flashed with one of the new lamps by the observer, for the few minutes each time it is observed upon. This reduces very materially the consumption of current and battery cost.

The lamp, after being provided with two additional bulbs, one for medium and one for short distances, was tested by the Bureau of Standards, with the following results:

Apparent candle power, at a distance of 100 feet. Lamp with specially concentrated filament, gas-filled, 6 volts, 2.5 amperes.....	250,000
Automobile lamp, 6 volts, 1.8 amperes	50,000
Flash light lamp, 2.7 volts, .34 ampere	6,000

The candle power of the acetylene lamp now used in the triangulation carried on by the Survey, measured under the same conditions, is 1,500.

A House Built With Fifty-Six Varieties of Cement

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the object of the tests has been to determine what mixture "weathers" best; in other words, which panel will stand the sun, wind, rain and freezing temperatures of out-of-doors and remain in good condition.

The principal hydraulic cements are termed natural cements, Portland cements and puzzolan cements. Natural cement is the product obtained by calcining an argillaceous limestone without pulverization or admixture of any other material, at a temperature above that used in burning lime, and by grinding the mass into a fine powder. Most of the cement used abroad is of this variety. It sets more rapidly, but has less strength than the Portland cement.

Portland cement was invented by an Englishman, Joseph Aspdin of Leeds, and was named for its resemblance to the limestone quarried on Portland Isle, Dorsetshire, England. It is a combination of silicates and aluminates of lime. Puzzolan cement, on the other hand, is a mixture of siliceous and aluminous materials and is not burned in manufacturing. It possesses the property of hardening in water.

As cement of some kind is one of the most universally used materials in modern life, the results of the experiment with the mixtures that go to make the walls of the Bureau of Standards' cement-testing house will be awaited with interest by the building world.

Mexico: Its Political Situation, Its Resources, and Its Military Strength

(*Concluded from page 451*)

Mexico City or from Monterey to Torreon would be an ugly if not a difficult problem.

Two railroads lead from Vera Cruz to Mexico City. Each is bordered by the remains of branches of the old royal road. These railroads pass, respectively, north and south of Perote Mountain in the first half of their routing, uniting at San Marcos. One branch then goes south of the Tlaxcallan Mountains through Puebla, the second city of the country; the other goes northwest through a fertile plain to Humantla. They unite again at Apam, and then run southwest to Mexico City, one on either side of Texcoco Lake.

This line offers some two hundred and twenty miles of as hard country for campaigning as can well be imagined; the distance is much greater by road or rail. There are numberless places on each branch where both railroad and wagon road can be so damaged by demolitions that weeks of repair work would be necessary before trains or motor trucks could pass. That the road has remained in operation practically throughout the various revolutions is proof positive of the absolute dependence of all classes upon it. Undoubtedly it would be destroyed before a foreign invader. And there are many positions, especially in the mountain passes, where a small but determined force could check an army of any size until outflanked by movements over the most difficult country, frequently impassable even for pack trains. Unending opportunities are offered for dashing guerilla operations against the long line of communications.

But these are difficulties only. A mountain country can delay an army, but only a position offering a broad field of fire, and having its flanks resting on impassable obstacles, can really hold indefinitely a superior force. And for such a defense an inexhaustible supply of ammunition is needed, as well as artillery equal in range to that possessed by the offensive. These last have been conclusively demonstrated by the great European war. Mexico possesses neither artillery nor reserves of ammunition, nor would she be able to obtain them. Eventually Mexico City, with the only source of supply, would fall. Its occupation would take a short time or several months, according to whether the invader were willing to stand comparatively large losses in battle or was careful to conserve his forces by making no step without complete preparation. Considering the sanitary conditions which prevail generally, it is probable that the former course would be the cheaper in expenditure of life.

The problem in the north is totally different. The country is open and generally given up to mesquite, a hardwood shrub—frequently forming almost impenetrable thickets. It would mean an invasion from Matamoras or Tampico, along the rivers or railroad for the necessary supply of water to the army. There are on neither route the difficult positions such as exist between Vera Cruz and Mexico City, but a delaying action could be fought anywhere. The defenders could use the railroad for supplies and reinforcements and destroy it as they retreated. It would be a tedious operation, and might be made costly by a well planned resistance. Mexico, however, has not the men nor the equipment to do more than delay a force approximating a division, especially if she were engaged elsewhere at the same time.

Fifty thousand well trained and well equipped men should be sufficient for the tasks described above. To render absolutely safe the lines of communication, a force equal in size to the fighting force, and possibly a little larger, would be required; these line of communication troops, however, need be only infantry well supplied with machine guns.

Such a campaign, as was intimated in the beginning of this article, would destroy Mexico as a political entity. Whether it would serve to restore order and bring unity to that unhappy country is a matter of doubt. Probably an invader could obtain any demanded concession of territory and any promise of indemnity, but most likely he would have to fight to subdue the territory ceded and wait a long time for payment of the indemnity.

For the restoration of peace in Mexico something more than violence is necessary. In fact, no violence not involving the killing of practically all the fighting men would accomplish this result. The first revolution was due to the birth of a desire for freedom, for a chance for the common people to be something more than peons. The masses have had a taste of liberty, if the word can be defamed by its use in connection with the license that has ruled. At any rate, they have ceased to be slaves, and will never go back to that status. Those who say that Mexico needs a strong man—a second Diaz—blind their eyes to every lesson of history. *Never yet have the masses definitely overthrown a government by class, a government based on injustice, and then again become subservient to the same class. That page in Mexico's history is closed.*

What Mexico needs is a government that makes secure the home of the common people. Given this and a voice in local affairs, and the appeal of the revolutionist would fall on deaf ears. At present Mexico is filled with men whose wives are hungry, whose children are starving, and with others whose families have died of disease or want, or both. The former, prevented from earning a living by the disorganization of all industries, hopeless of obtaining employment of a peaceful nature which will supply the needs of those dependent upon them, turn to a life of violence, which alone promises even temporary relief! the latter, having lost everything held dear, and actuated in many cases by a desire for vengeance upon the party they hold responsible for the disordered conditions, are careless of life, and will enlist in any cause opposed to that they hold blameworthy. Hence endless disturbance and innumerable lawless bands preying on the helpless and adding new numbers to those who have lost hope.

The condition is identical with the one we met and solved in the Philippine Islands. After the dissolution of Aguinaldo's unstable and incomplete control of the islands, we had many local leaders to deal with. The first step was to break down the remnants of organized resistance, a simple task, for we had the organized military force to do it. Following this came serious complications. In many cases the officials, appointive and elective, who worked openly for the American government, worked at the same time sub-rosa for the secret government of our opponents; they collected taxes for us, and at the same time and by the same machinery for our enemies. And the friend of the day might be the enemy of the night. A section of the country strongly garrisoned would be peaceful; withdraw half the troops, and the arms and uniforms (carefully concealed while resistance was useless) would be brought out, and a new uprising would occur. The return of the troops in force meant the disappearance at once of the enemy, and the reappearance of the white-clad, urbane, smiling *amigos.**

* Spanish-friends. The soldiers used it as a term for the treacherous natives who were openly loyal and secretly hostile.

We had to gain friends, and did it, by justice. Gradually, more and more, the people began to realize that we were to be trusted. The women discovered that their daughters were safe from violence, that the sanitation we enforced meant that their babies could live, that their children—all of them—were to be taught to read and write. Young men and young women desiring to marry found that they could establish a home and would be protected therein. And all the people found that we would not only permit them to elect their own local officials and leave the details of local affairs to them, but that we honestly desired just that thing. In other words, we restored *hope*, without which humanity becomes desperate.

Secret opposition ceased, more coöperation and honest coöperation was increasingly evident. Soon there remained only the bandits, and it is a fact that of these 90 per cent were captured through their own people. As a result, while we may not have the open gratitude of the Filipinos, we have their sincere regard, and among them is a degree of loyalty unsuspected by Americans who have not gone among them freely and whose observations have been confined to political hotbeds such as Manila.

It is this result in Mexico that our Army officers have in mind when they state that the solution of the Mexican problem will call for half a million of men over a period of five years. There is, among some of our people, an idea that peace cannot come to Mexico unless we take that action. It would be a gigantic task, a thankless task, and a very expensive undertaking.

But such intervention will be entirely unnecessary if Mexico can throw aside her baseless suspicions of our motives, and accept the aid we have so completely shown it is our desire to give. If any leader of influence among them would call their attention to the hopelessness of their situation should the protecting mantle of the Monroe Doctrine be withdrawn, would point out the long years of anarchy and wrong to all foreigners that we have suffered rather than hurt their national pride, would frankly tell them that the United States has proved its friendship for Mexico and is the only friend she has powerful enough to protect her and anxious to help her—if such a leader would adopt and enforce a system of justice to all, high and low, in the section he controlled, he could easily obtain substantial aid and support from us, and those who opposed him would be cut off from supplies. It would require a man of large courage, for it is to be feared that baiting the "Gringo" in Mexico is today as popular politically as the word "independencia" was in the Philippines before the people began to understand.

The Mexican leaders must realize their utter helplessness for self-defense should any powerful nation care to intervene; they must realize that Mexico (for internationally she is responsible for any act committed within the bounds of the republic) has committed deeds during the past few years justifying the intervention of many different nations; they know that many of these acts have been against the bodies and property of citizens of the United States; they cannot fail to appreciate in their secret hearts that, but for us, others would long since have exacted reparation, and of the educated class none can be so blind as to overlook the patent fact that our Government has withheld its own hand under the severest provocation. Our present expedition into Mexico is as strong a proof of our friendship as could be desired. We have sent our troops into what would probably be the very last section of the country selected by a military strategist or by a statesman who had the injury of Mexico in mind.

Patriotism, common sense, nay, even the first law of nature, self-preservation, all demand that the Mexicans shall forget an ancient and wornout racial hostility and frankly accept the hand of friendship which has been extended to them for these weary months and years. Have they the leader wise enough to point the way? In spite of every discouragement, we must still hope so, for it is the confidence and friendship of a united America we so earnestly desire, not the political control of our weaker brother American republics.

War Game—VII

(*Concluded from page* 453)

in its wake.

If you will recall the problem in the service of security, explained in War Game II, you will know that it is certain that Red patrols are combing the territory. For this reason the advance guard of the Blue Brigade will sooner or later encounter Red patrols. More than likely the Red patrols will listen and hear the inevitable sound of tramping feet. The patrols will evade an encounter in order to procure information as to the strength of the Blue forces. The Reds have a comparatively large force of cavalry, and such patrols can easily transmit their information to headquarters. It must therefore be assumed that before the advance guard of the Blue Brigade could pass Oregon Farm the Red commander will be aware of the fact that strong enemy forces are threatening his right flank. This information might lead to an early counter movement on his part.

A glance at the edge of Lebanon Forest will show what a splendid defensive line is at the service of the Red commander if he wants to fight a long delaying action to gain time for the arrival of his main forces from the north. The strength of the position lies in the advantage of the covered defensive line offered by the forest, with a stretch made unapproachable by Green Lake. Good communication with Greenville is afforded, and a clear approach in front offering very little cover for the enemy. Otter Creek, which divides the line, is a great disadvantage, making it nearly impossible to shift reserves from one flank to the other. All of these items are important, for they bring out clearly the possibilities of the coming engagement.

Under any circumstances, the Red commander would make his plans to resist an attack directed against his right flank.

The Reds are the invading force. They are in territory hostile to them. Their cavalry regiment has six squadrons of 140 men each. The infantry battalions number 700 men each. The Red losses in dead and wounded are 70 men. This would put their fighting strength, with the battery, at slightly over 3,000 men.

Against this force the Blues have over 6,000 men at their disposal. The odds are rather over two to one. This is undoubtedly an overwhelming strength. Nevertheless, a defensive position could be successfully held by the Reds against these odds.

Aside from their numerical superiority, the main advantage which the Blues have is their opportunity to strike a surprise blow. This is the double envelopment of the Reds, chiefly made possible by the fact that Colonel K secured the two steamers for this very purpose.

Developments during the Night, and in the Morning

The infantry fire has practically ceased. Occasionally it flickers up, like a half-burned log in the fireplace, only to die away again. At the least suspicion of a movement by the enemy a light rocket whizzes into the sky to give ghostly light to the battlefield. The hours pass draggingly. Colonel K takes every opportunity to get a bit of sleep, for he must be strong on the morrow. His staff, however, is on the lookout.

At 11:00 P.M. Colonel K is awakened by his adjutant and is advised that a signal message has been received from the brigade commander:

Railroad Bridge,
Southwest of Pottstown,
7 June, 19—, 10:30 P.M.

Two battalions have embarked on river steamers and will leave here at 11:00 P.M. to land above Timcum Creek on right shore of Nehaminy.

Your platoon of engineers will be at

the disposal of and receive orders from Major M, commanding the detachment.

I will make a holding attack on the enemy at 4:00 A.M. to-morrow, to give time for Major M's movement.

As soon as the enveloping forces of Major M attack the enemy's left flank you will advance in full force.

I shall be on peak of Lookout Hill.

G,
Brigadier General.

Colonel K can now continue his interrupted sleep if he so desires. The plans are well laid for success.

With the first signs of dawn the field of action begins to waken. The infantry fire, which heretofore had pattered intermittently, now becomes a continuous rattle. With the first rays of the sun, when the mists begin to lift, the deep boom of the guns mingles in the concert. Little white puffs of smoke, born of powder fire, appear and vanish over the fighting lines; clouds of dust rise underneath the bursting shrapnel. And in this apparent confusion the troops, the commanders and every portion of the forces, move, think, direct and carry out, each its own particular duty.

At 4:30 A.M. the enemy artillery has been forced to retire to the forest edge, and the dismounted cavalry follows gradually and in good order.

At 5:00 A.M. the Red infantry begins to retire. They attempt a withdrawal across Timcum Bridge, but the reserve battalion alone succeeds. The other two battalions retire gradually, with considerable loss, toward Lebanon Forest. The reserve battalion, which recrossed Timcum Creek, is headed toward the forest edge, northeast of Green Lake.

This movement continues until 5:40 A.M., at which time Colonel K advances his right. One battalion of the brigade pushes forward to Hoard's Dairy. The enemy has reached the edge of the forest and has developed a stronger firing line.

At 6:15 A.M., from the east, Major M attacks and surprises the enemy. Having waited for this movement, Colonel K orders a general advance of his detachment.

Questions

Question 1. The situation of the Blue Brigade at 10:30 P.M., is shown on the map. Using this as a basis, mark the position of the same forces at 1:30 A.M. As we have stated before, infantry marches at the rate of three miles per hour. Considering that this is a night march it will be advisable to figure that only 2½ miles per hour is covered.

Question 2. The speed attained by the river steamers is 6 miles per hour. Where will these transports be at 1:30 A.M.? Consider here also that the movement is made at night.

Question 3. Suppose that Major M decides to land at a point slightly over 2 miles up-stream from the mouth of Timcum Creek, at what hour of the night will his force be in readiness on the shore? Provided, of course, that the engineers have to make a pontoon landing with the aid of the small boats.

Question 4. Compose an order for this landing. Remember the enemy, our own forces, a plan of action and the commander's intentions.

Question 5. How will the force making the surprise attack move towards its destination? In march order, in line or in columns?

Question 6. The two battalions safely landed on wooded meadow are in readiness for the march. Issue an order to be given by Major M to the patrols which he will send out.

Question 7. The two battalions have reached Chester Hilltop at 4:30 A.M., and the firing of the holding attack begins. What order will Major M give?

Answers to Questions in War Game VI

Question 1. This will involve the cutting out of small strips of cardboard to fit the troop signs. It is a good plan to make special signs for deployed companies, and where this is needed, to exchange the close formation signs with the deployed sign, and vice versa.

This simple, but tedious exercise will come in handy in the later War Games.

Question 2. Considering the advance in the beginning of the engagement, it is safe to suppose that the battle has exhausted all the company reserves. Now we know that two battalions have been engaged in the firing line, and that originally each of these battalions sent two companies on the firing line.

As soon as the company reserves are exhausted, the battalion commanders will send another company ahead to carry forward and strengthen the firing line. This will, most likely, put another platoon on the firing line and hold the remaining platoons for company reserves. Therefore, the one must replace the other in due time. In this present case, the long drawn-out combat will have exhausted the battalion reserves. But the detachment reserve, one battalion strong, should still be available.

Question 3. The advantage of taking a position under cover is self-evident. As we have before stated, artillery can be used just as successfully when the gunners do not see the target, as when they are in full sight of the enemy. This sort of firing is called *indirect fire* and is guided from an observation point. From the top of a tree or roof of a house, etc. It will offer better protection without diminishing the fire effect.

Question 4. The artillery, in this case, is in a masked position and its fire is directed by reference to the so-called *aiming point.* The aiming point is in clear sight of the gunner laying the gun, and this point is selected in such a way that, with the elevation given to the gun it will direct the fire upon the invisible target. See diagram.

Question 5. Full and complete answer will be found in War Game VII, under chapter "Considerations in regard to Present War Game."

Question 6. Either he must decide to retreat to forest edge with all his forces, or he might effect the partial withdrawal of his Infantry behind creek. His order will simply point out new line of defense: the *edge of* Lebanon Forest.

* * * * * * *

The next War Game will deal with a piercing attack and will introduce entirely new formation and situations.

Recent Patent News from Washington

WE commented some time ago on a bill which had been presented to Congress, the object of which was to prohibit members of Congress from lending their names for advertising purposes to persons, firms or corporations practicing before the Patent Office. Serious abuse has arisen during the past few years in which patent attorneys have obtained letters of endorsement from members of Congress, which they have used to promote their private interests and to extend their business.

In most cases it was evident from the tenor of those letters that the members of Congress who have thus been persuaded to lend their names have had no personal knowledge of the ability or business methods of those attorneys, and the use of this method of advertising has become such a scandal that it was deemed necessary to put a stop to such practice. One of these firms even went so far as to publish in a pamphlet advertising its business the portrait of the Speaker of the House.

That something should be done to put a stop to such practices has been recognized by Congress itself, in the fact that it has passed the bill to correct such business methods.

Owing to the unusual growth of the patent business of the country during the past few years, Commissioner of Patents Thomas Ewing, urges additional space for the Patent Office. In a letter to Secretary Lane, of the Interior Department, he asks for the second and third floors of the building, now occupied by the General Land Office, for the use of five divisions of his force—classifications, draftsman's, assignment, manuscript and photolithographs and publications. Commissioner Ewing says in his letter:

"It is only relieving this building of the five divisions of the Patent Office that we can make the proper disposition of the force which the demands of its work make necessary."

The need of 100 per cent expansion for the five divisions indicated is expressed in the letter.

Commissioner Ewing urges the provision of additional stacking facilities for the copies of patents which are on sale to the public at the office. There are 1,400,000 patents, he states, and, working on the basis that it takes 1 foot of stacking space to take care of 16 patents, he figures that it will take 87,500 feet for the whole. The widening of the aisles between the stacks and the installation of steel shelving to minimize the constant danger of fire are advocated.

NEW BOOKS, ETC.

QUESTIONS AND SOLUTIONS IN TELEGRAPHY AND TELEPHONY. Final Examinations. Compiled by H. P. Few. London: S. Rentell & Co., Ltd. 12mo.; 74 pp.; illustrated. Price, 1s. 6d. net.

This slim handbook is issued as a companion volume to the same author's "Questions and Solutions in Telegraphy and Telephony, Grade 1 Examinations." It gives in full all the questions set by the City and Guilds of London Institute, in both telegraphy and telephony, for the ten years, 1906-1915, and to the questions of 1915 are appended full solutions.

MISS AMERICAN DOLLARS. A Romance of Travel. By Paul Myron. Milwaukee, Wis.: Mid-Nation Publishers, 1916. 8vo.; 301 pp.; illustrated.

Although cast into fictional form, Judge Myron's story leads up to a consideration of the attitude of the United States toward the war, and toward our own preparedness. Some very caustic criticism is placed in the mouth of an intelligent French woman, who is disgusted at our worship of mere size and quantity; and, although she later repudiates much of its exaggeration, it is evident that the aim of the author is other than merely to entertain, and that he seeks to awaken the country to the dangers of self-sufficiency and carelessness. His intimate acquaintance with foreign lands gives us many authentic glimpses of Italy, Greece, Turkey, and Albania, with their tense political situations and interesting social conditions.

THE INTERNATIONAL MILITARY DIGEST ANNUAL. 1915. A Review of the Current Literature of Military Science. New York: Cumulative Digest Corporation, 1916. 8vo.; 390 pp.

It is no easy matter for our officers to keep thoroughly in touch with the military literature of the day. Much important material appears only in foreign languages; and even if they confine their reading to such articles as appear in the mother tongue, the volume of material is staggering. The need of expert translation and selection is apparent, and this need, in spite of the difficulties attending new enterprises of this kind, is being capably met by "The International Military Digest," a monthly publication, from which this annual is cumulated. The abstracts, varying from one-fifth to one-twentieth the length of the original articles, carry citations referring the reader to the original source. They are well chosen and in the highest degree informative. The widest range of subjects is covered, from aviation and ammunition to wounds and X-ray technique, and the alphabetical arrangement, with its system of cross-references, is an admirable aid to easy reference.

THE "SHIPPING WORLD" YEAR BOOK. A Desk Manual in Trade, Commerce and Navigation. Edited by Evan Rowland Jones. London: The "Shipping World" Offices, 1916. 8vo.; 2,010 pp.; with new map of the world. Price, 11s.

The "Shipping World Year Book," a standard publication of British origin, long ago entered upon a wide sphere of usefulness among commercial and shipping interests. Recently, many important alterations in port dues and charges have been made, and these are duly incorporated in the text; during the past year the loading and discharging facilities and the cargo accommodation and equipment of many ports have been substantially increased; these particulars are of vital interest to the shipper. The modifications and amplifications of existing tariffs—Australia, for example, has an entirely new tariff—have been numerous, entailing minute revision of this section of the Year Book. A new map, especially prepared by J. C. Bartholomew, plainly shows the world's steamship and railway routes, its ports, coaling stations, and coal fields, while among the many insets is one of the Panama Canal, tracing the waterway and its ports from Colon to the Pacific. The war has made necessary the retention of some old figures relating to subjects such as the tariffs of enemy countries; since, however, these countries are, for the most part, cut off from oversea trade, the omission of the latest statistics in no wise impairs the value of the Year Book as a work of reference.

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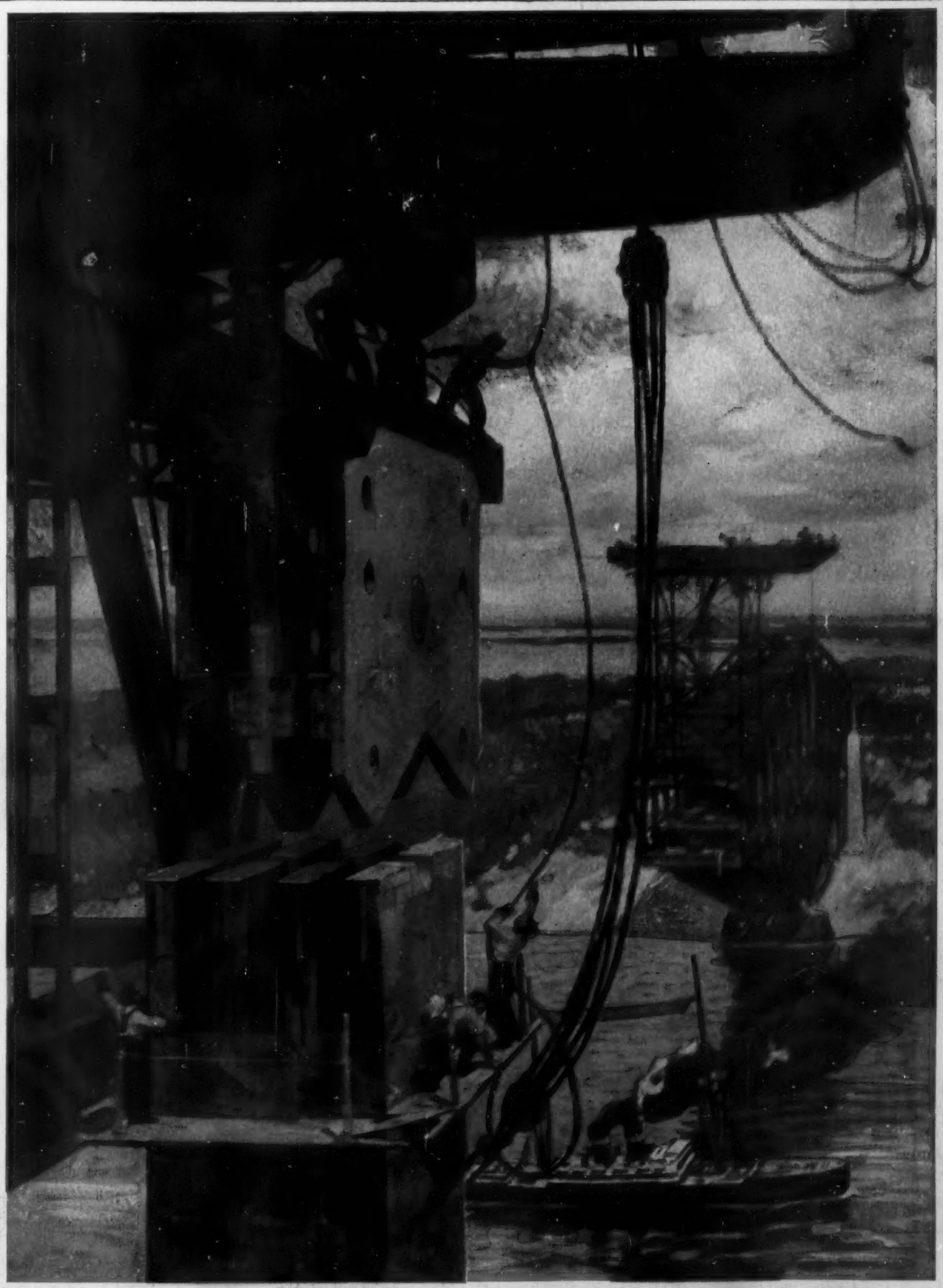

May 6, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 15 Cents

A STATEMENT

Concerning Final Drive in White Motor Trucks

IN VIEW of the conflicting claims for this form and that form of final drive which now confront the purchaser of heavy duty trucks, this Company, as the largest manufacturer of motor trucks in America, deems it fitting to make a public statement of its own purpose and practice in the matter.

White Trucks of over two tons capacity have always been chain-driven, and *will continue to be chain-driven* until some other form of final drive is developed in the future which is more efficient or equally efficient. In its present stage of development, worm drive will not be adopted by this Company, and White engineers now see no prospect of its basic handicaps ever being sufficiently overcome to warrant its adoption.

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3. They consume less gasoline, getting as high as 50% more mileage per gallon.
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That preference is well known. It is eloquently reflected in the fact that in total annual sales White Trucks predominate two to one of any other make, and among many large users they predominate ten to one.

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The army engineers demanded a truck that would consume as little gasoline as possible. The Jeffery engineers fitted the Quad with the duplex governor—the "automatic chauffeur"—which automatically regulates the supply of fuel necessary to maintain any given speed over any kind of road or trail.

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168 have already gone to Mexico to supplement the 50 previously in army service. In everything the demands for ordinary and extraordinary service at low cost are met successfully.

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